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Title:
The sedimentology and stratigraphy of the permo-carboniferous Grant group, Barbwire Terrace, Canning Basin, Western Australia.

THE SEDIMENTOLOGY AND STRATIGRAPHY OF THE PERMO-CARBONIFEROUS GRANT GROUP, BARBWIRE TERRACE, CANNING BASIN, WESTERN AUSTRALIA.

Volume 2

Figures, Plates and Appendices

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A thesis submitted to the University of Bristol
in accordance with the requirements for the degree
of Doctor of Philosophy in the Faculty of Science,
Department of Geology, August 1990.

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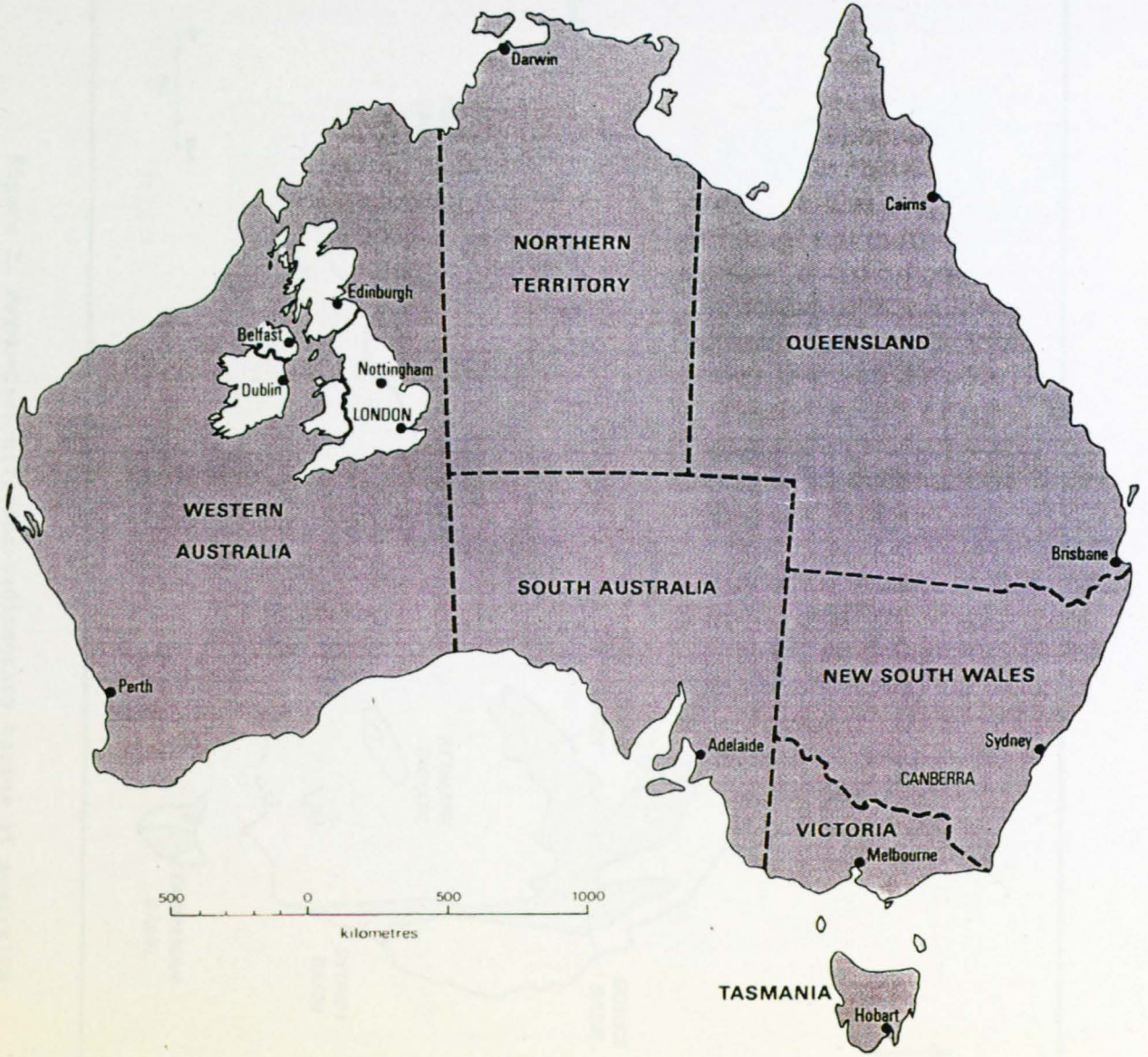

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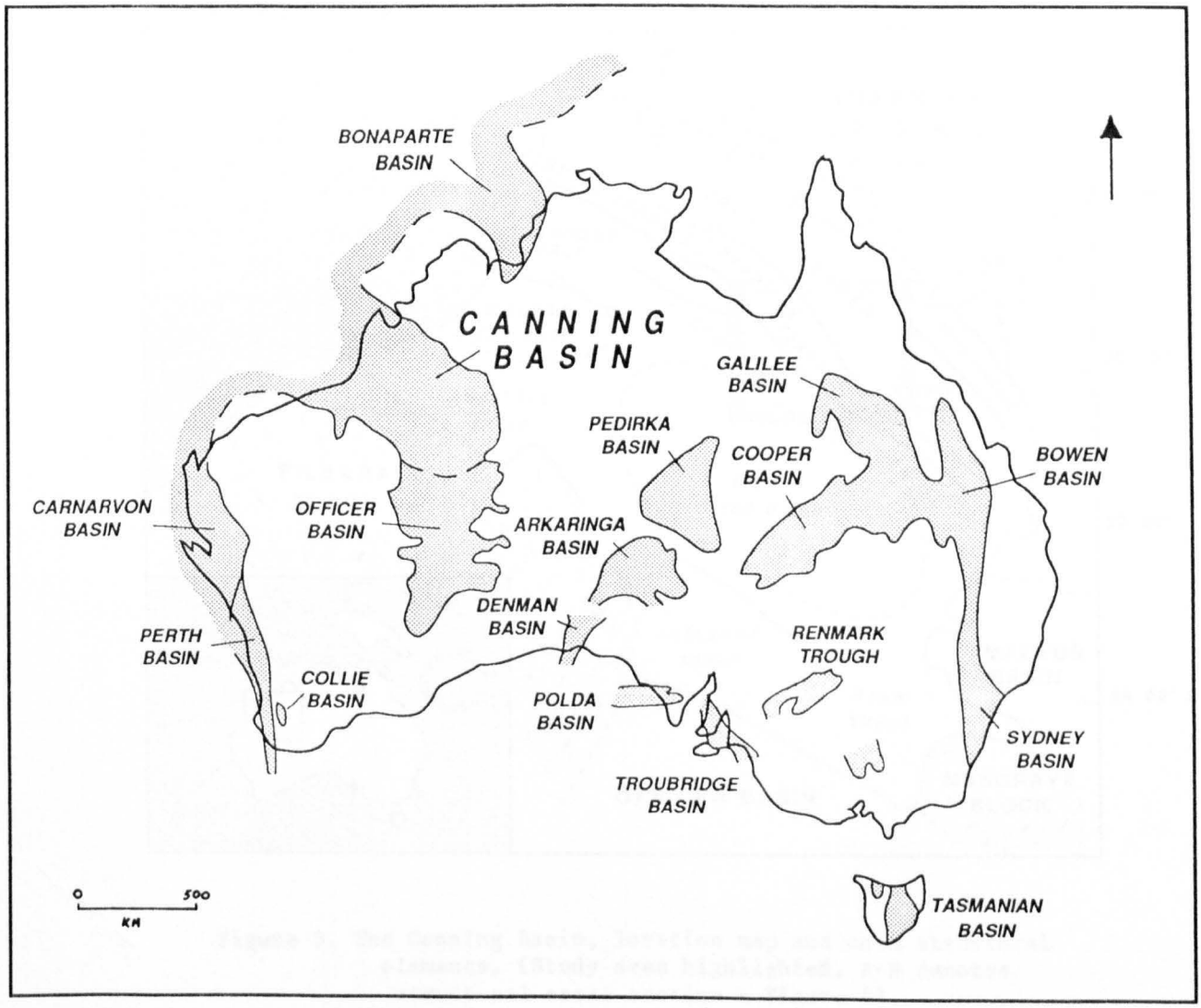

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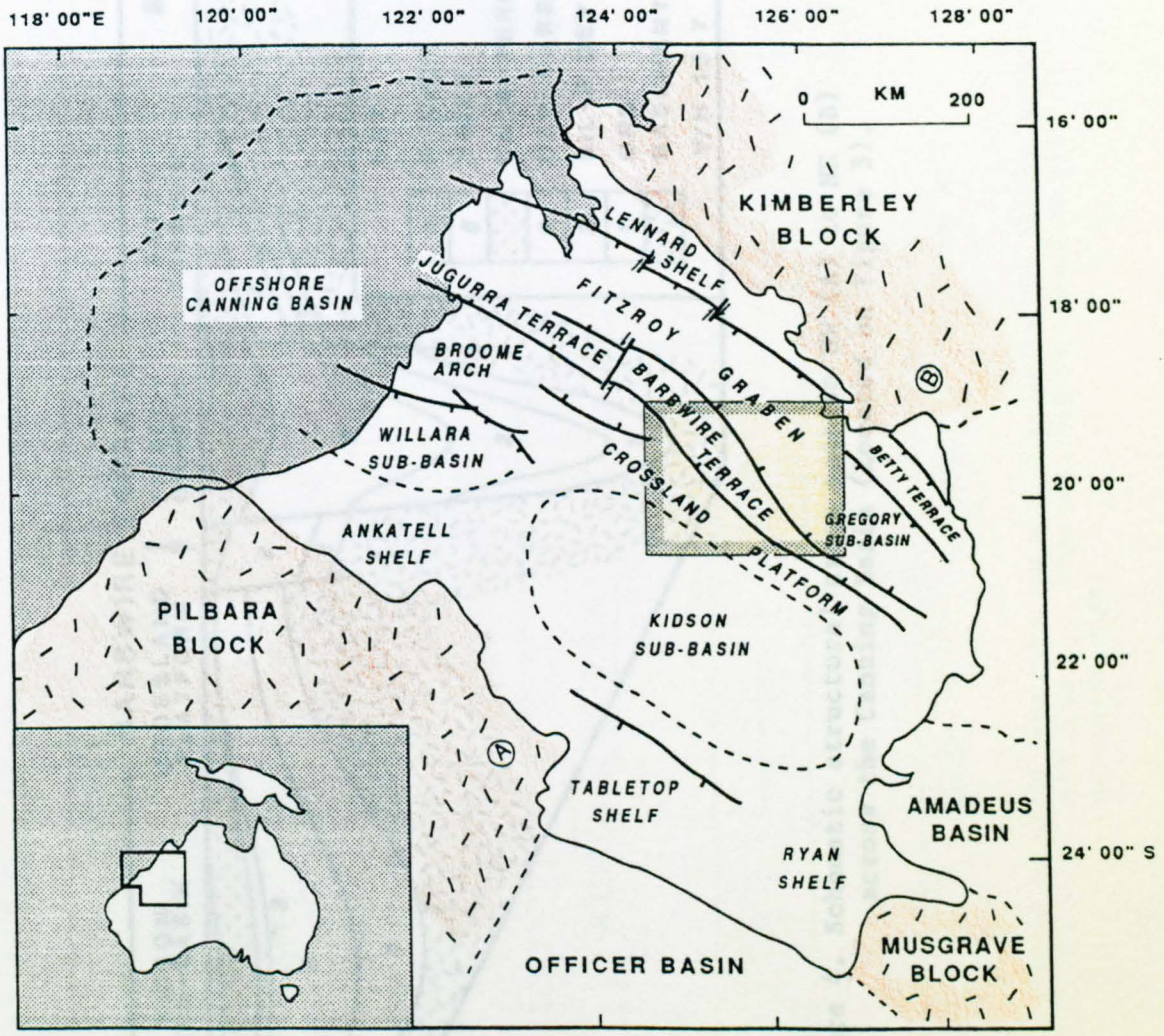

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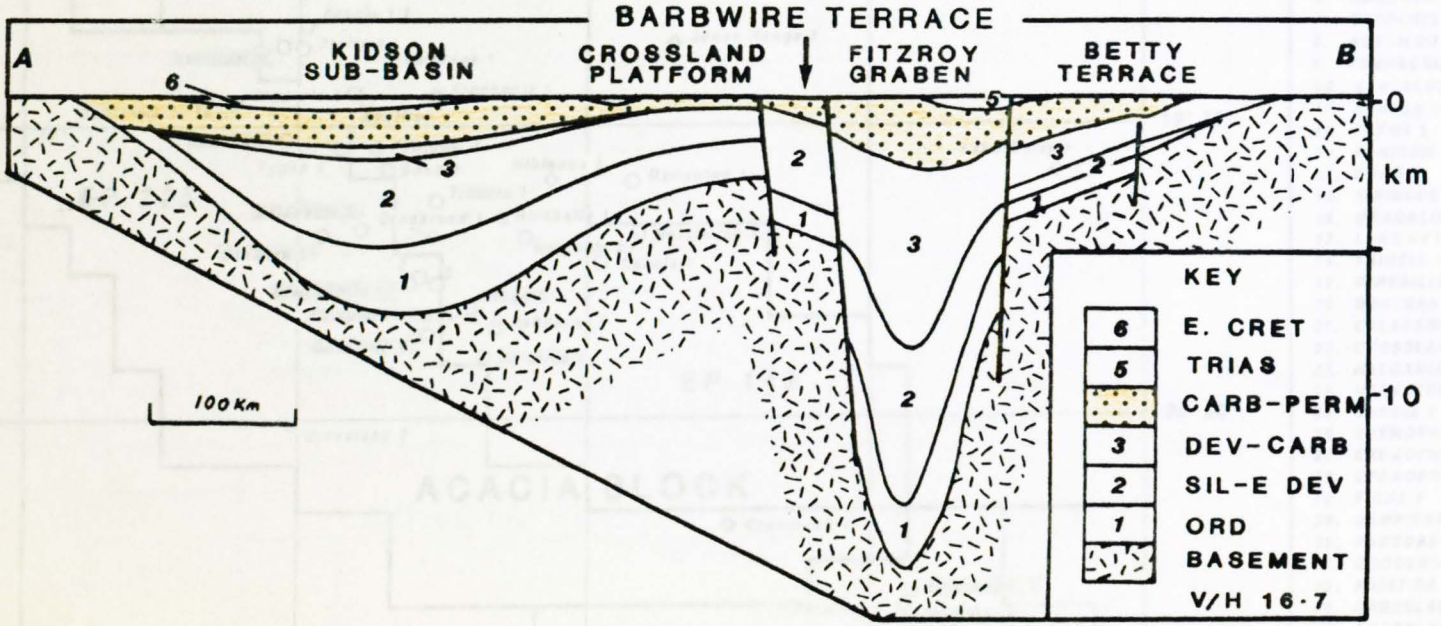

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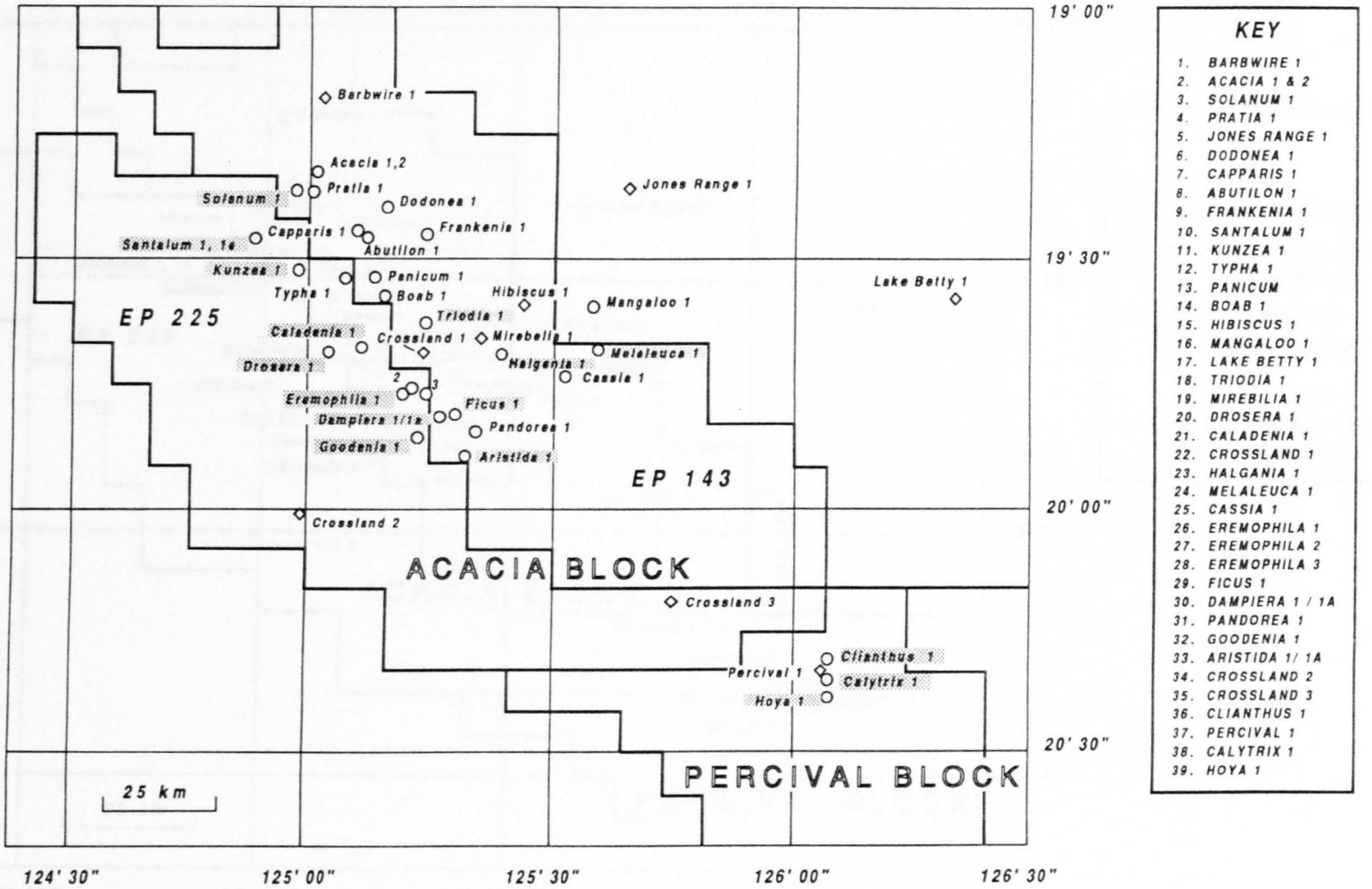

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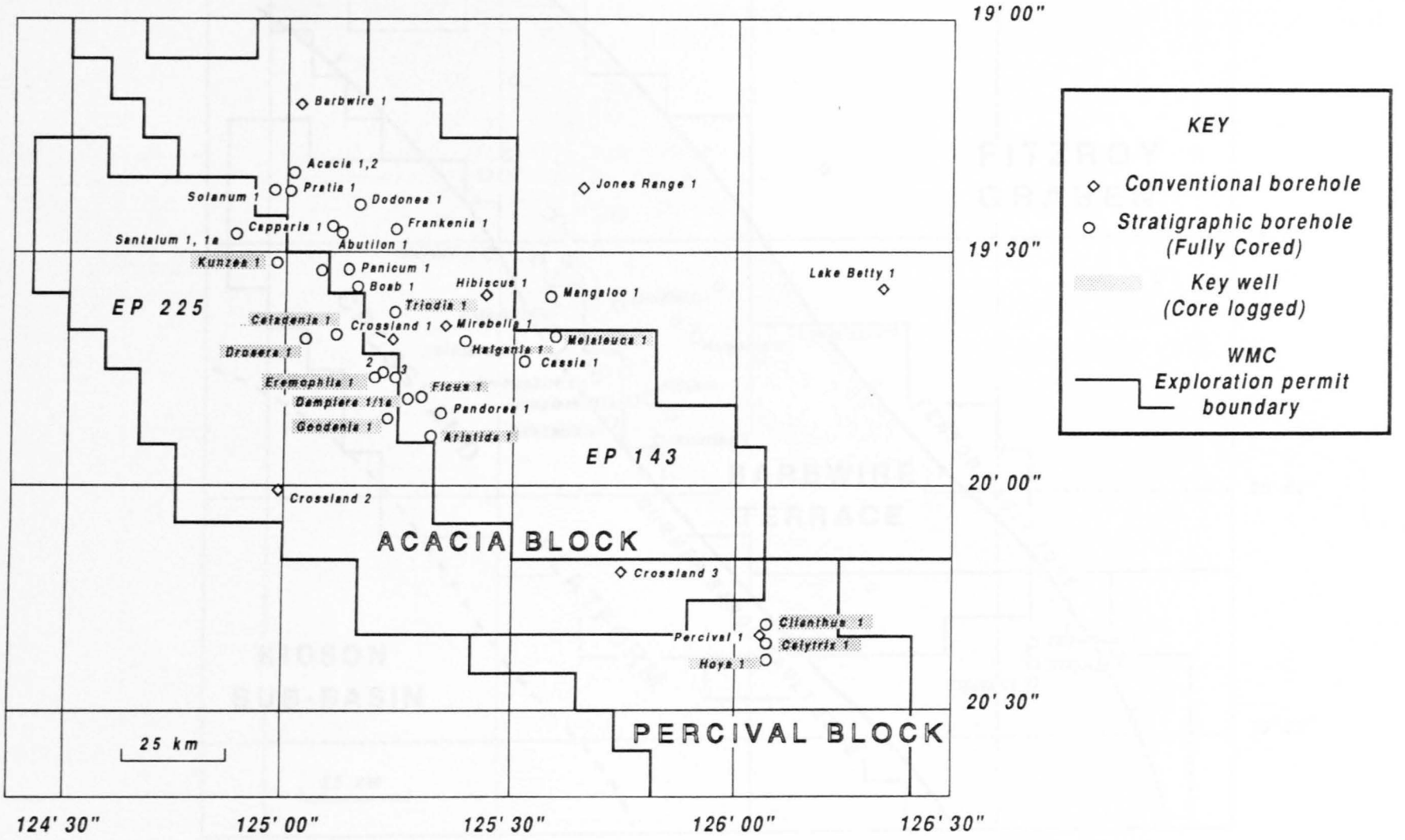

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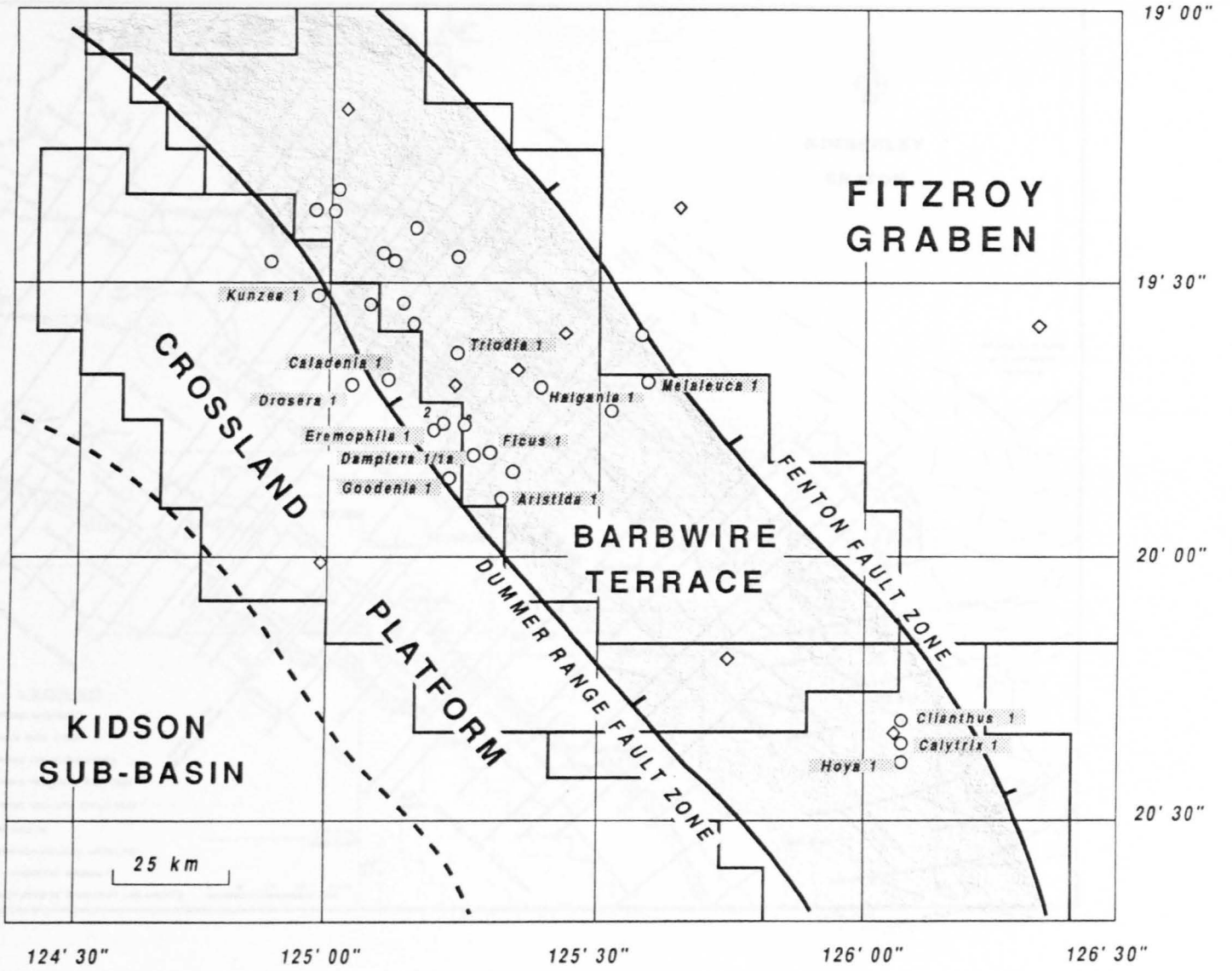

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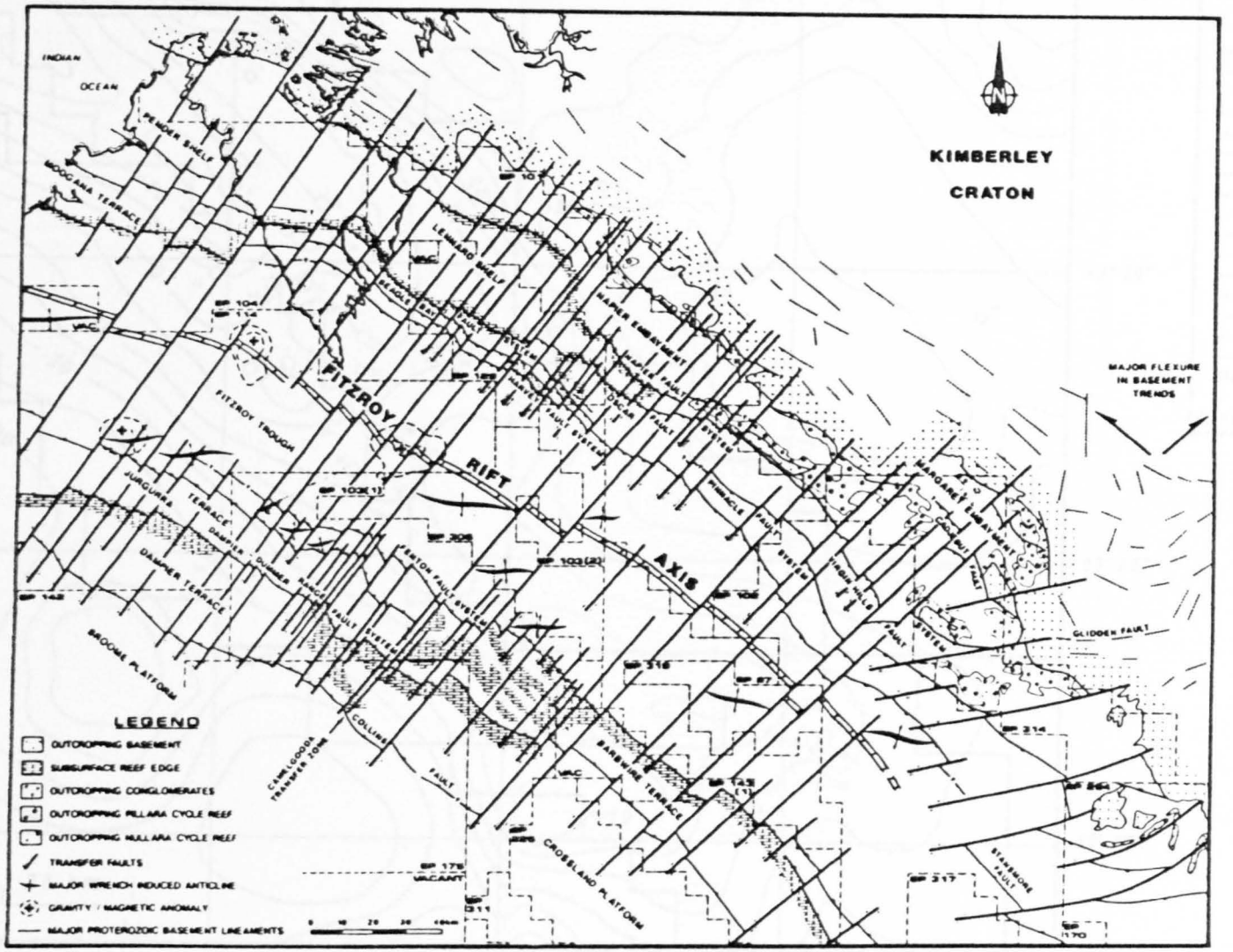

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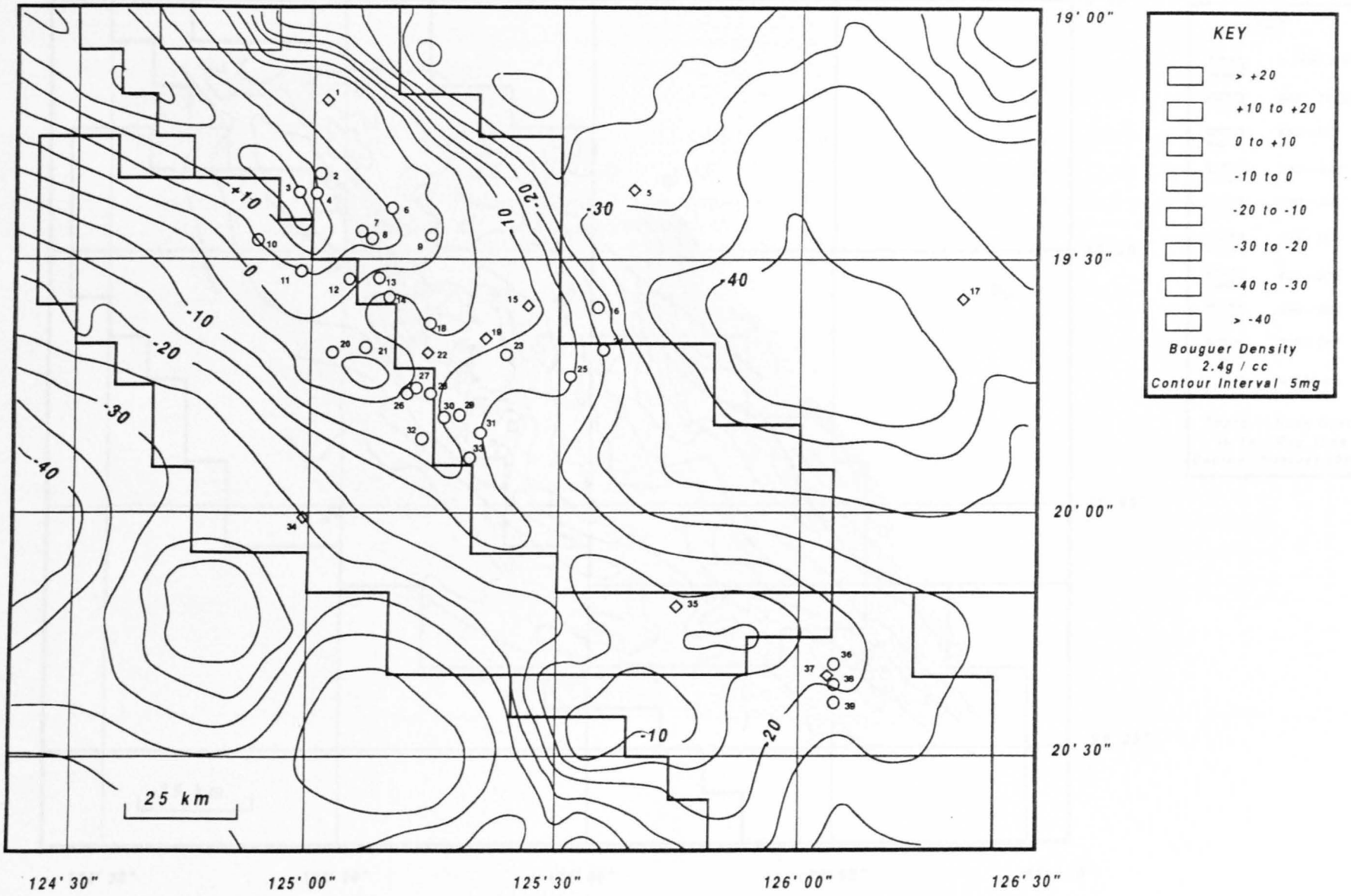

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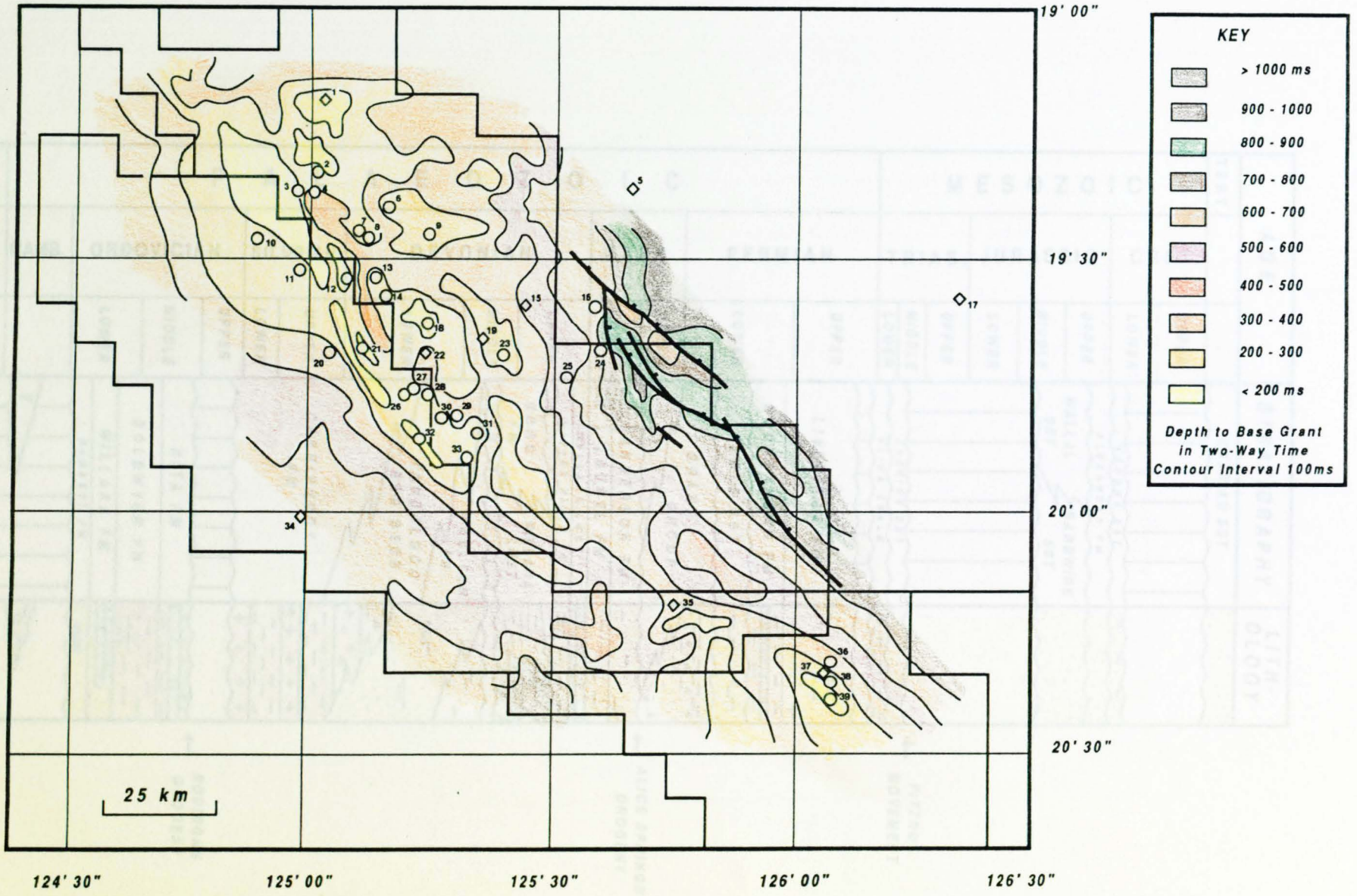

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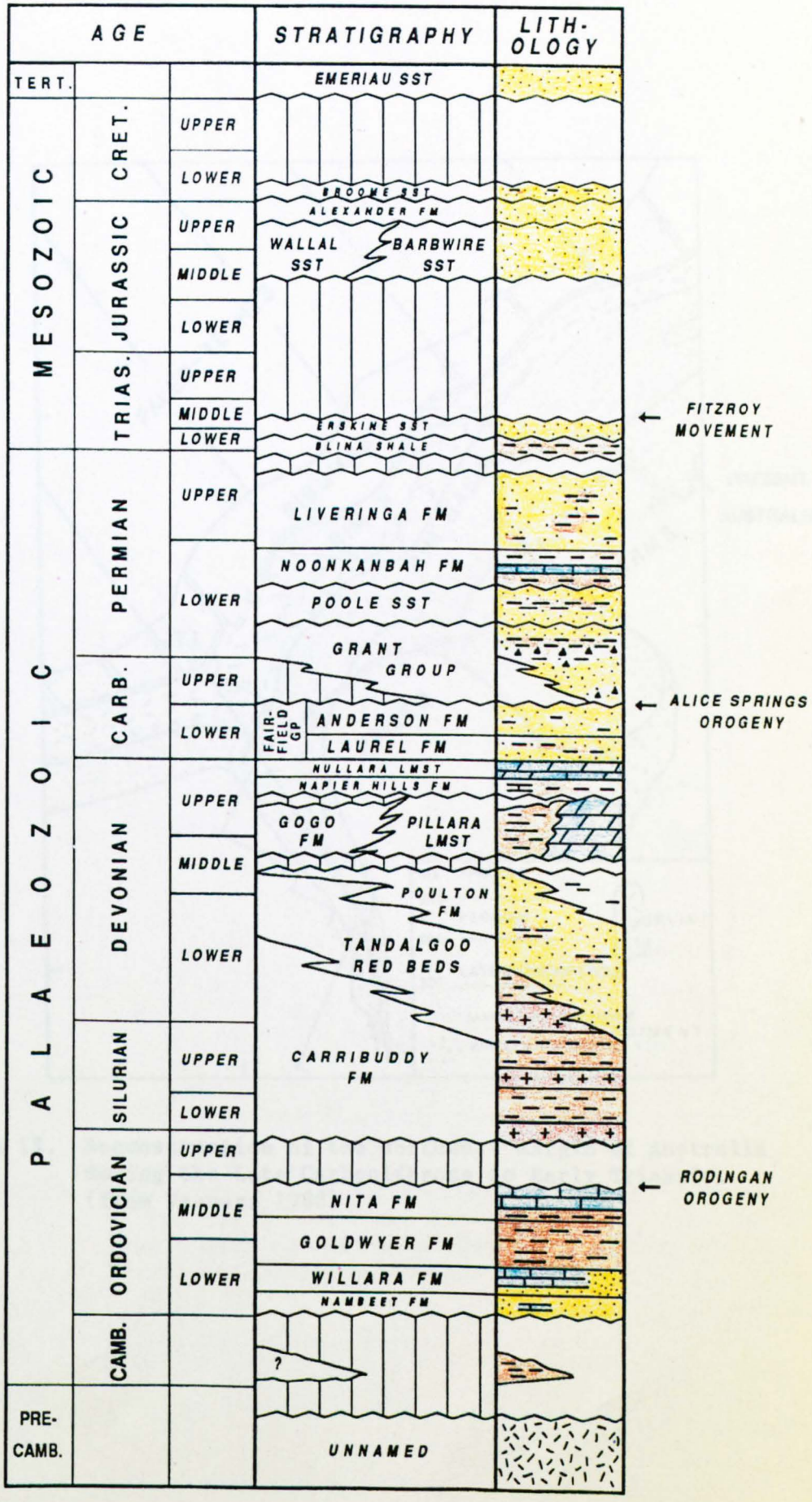

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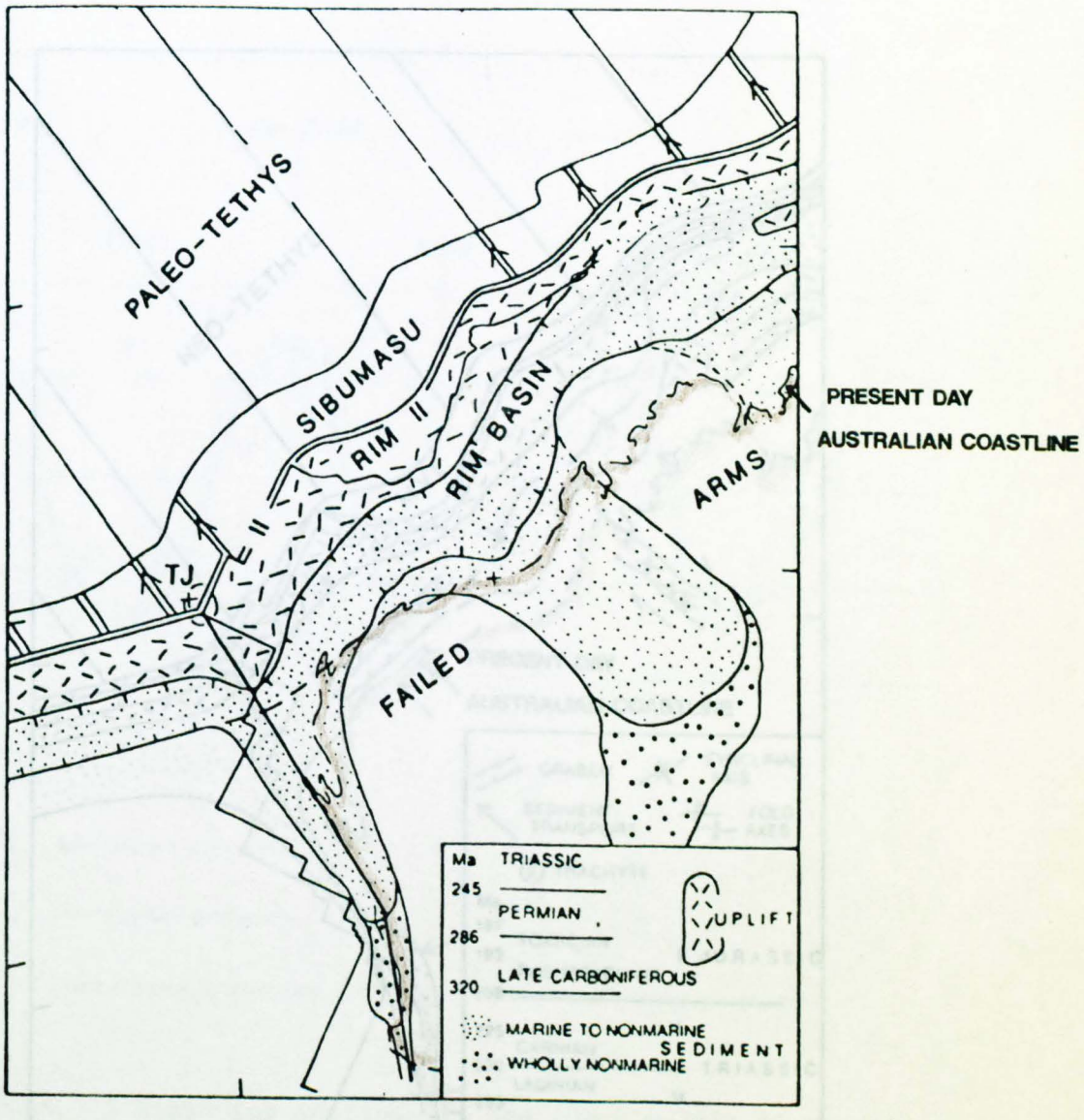

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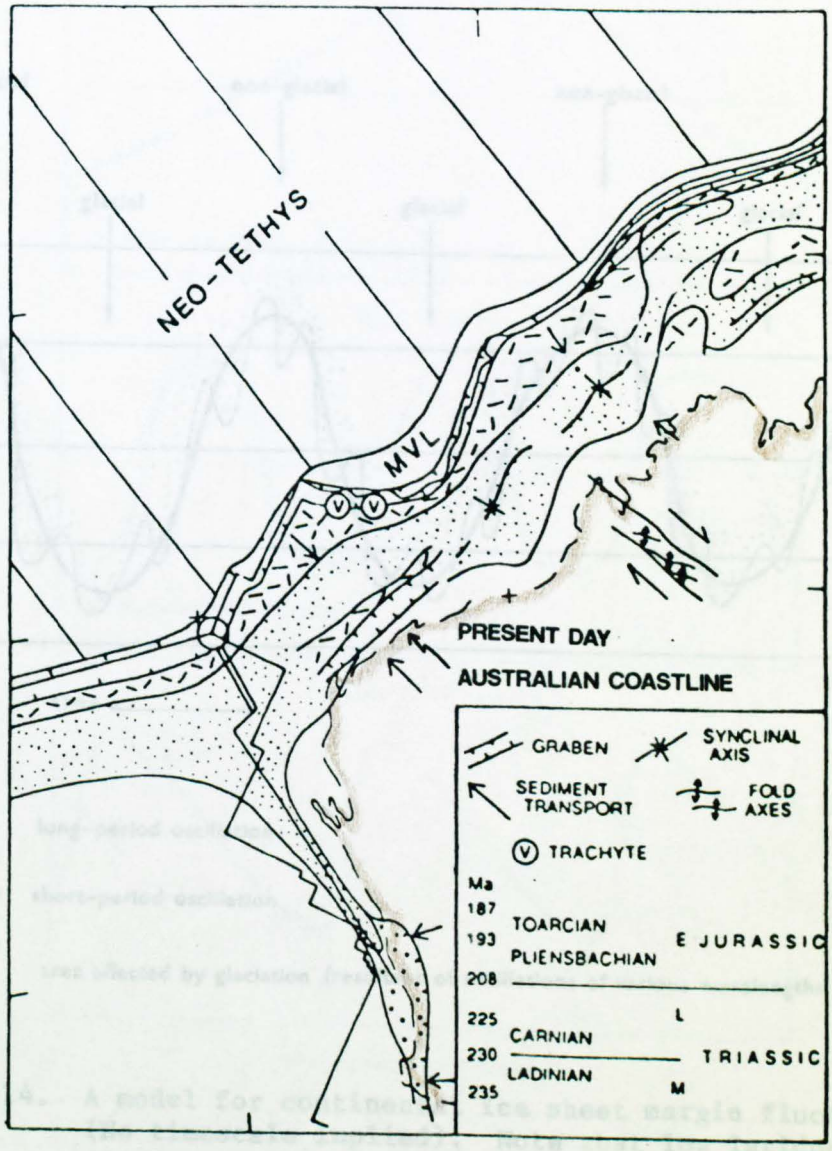

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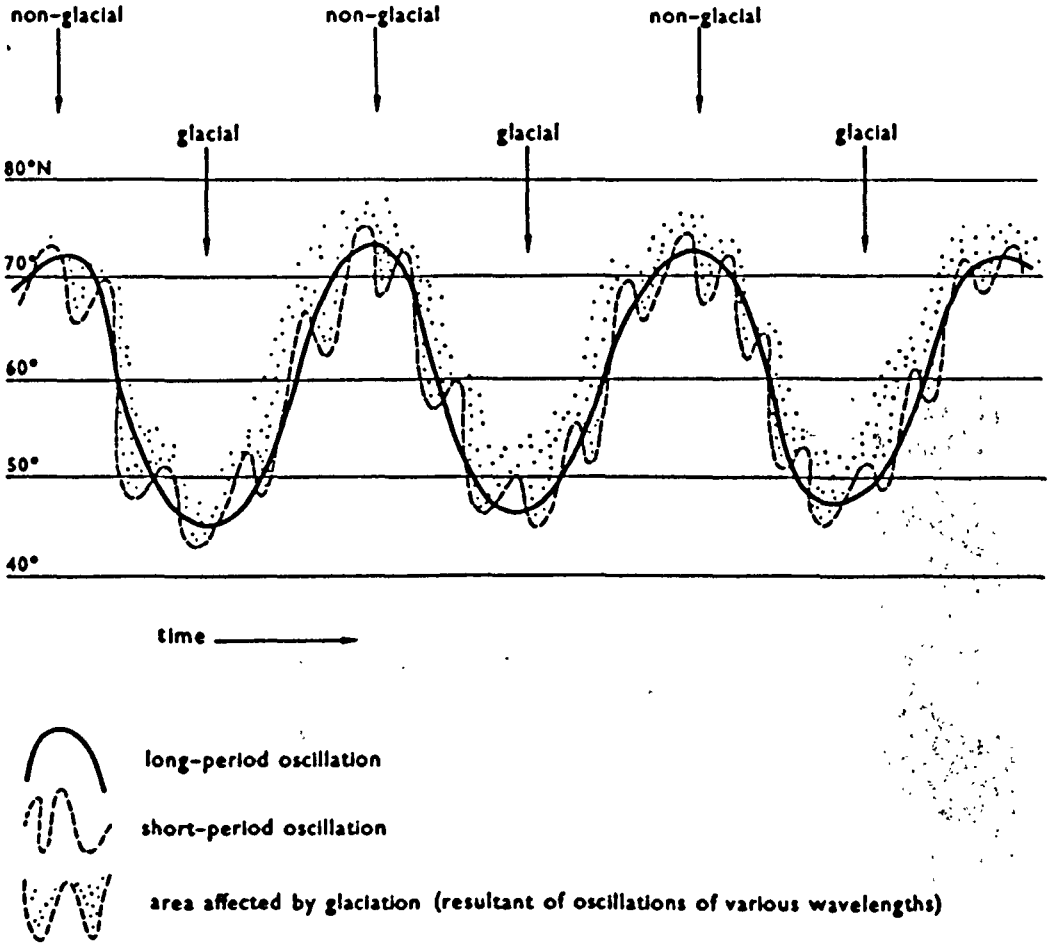

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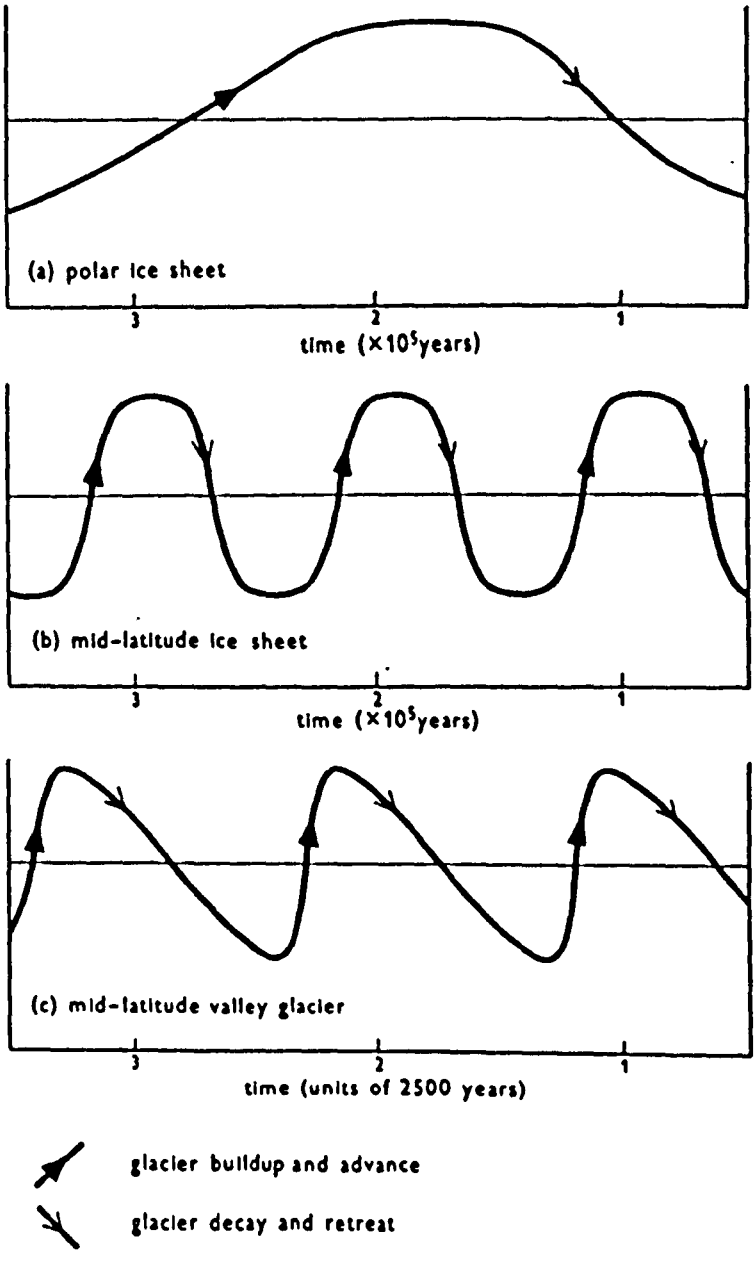

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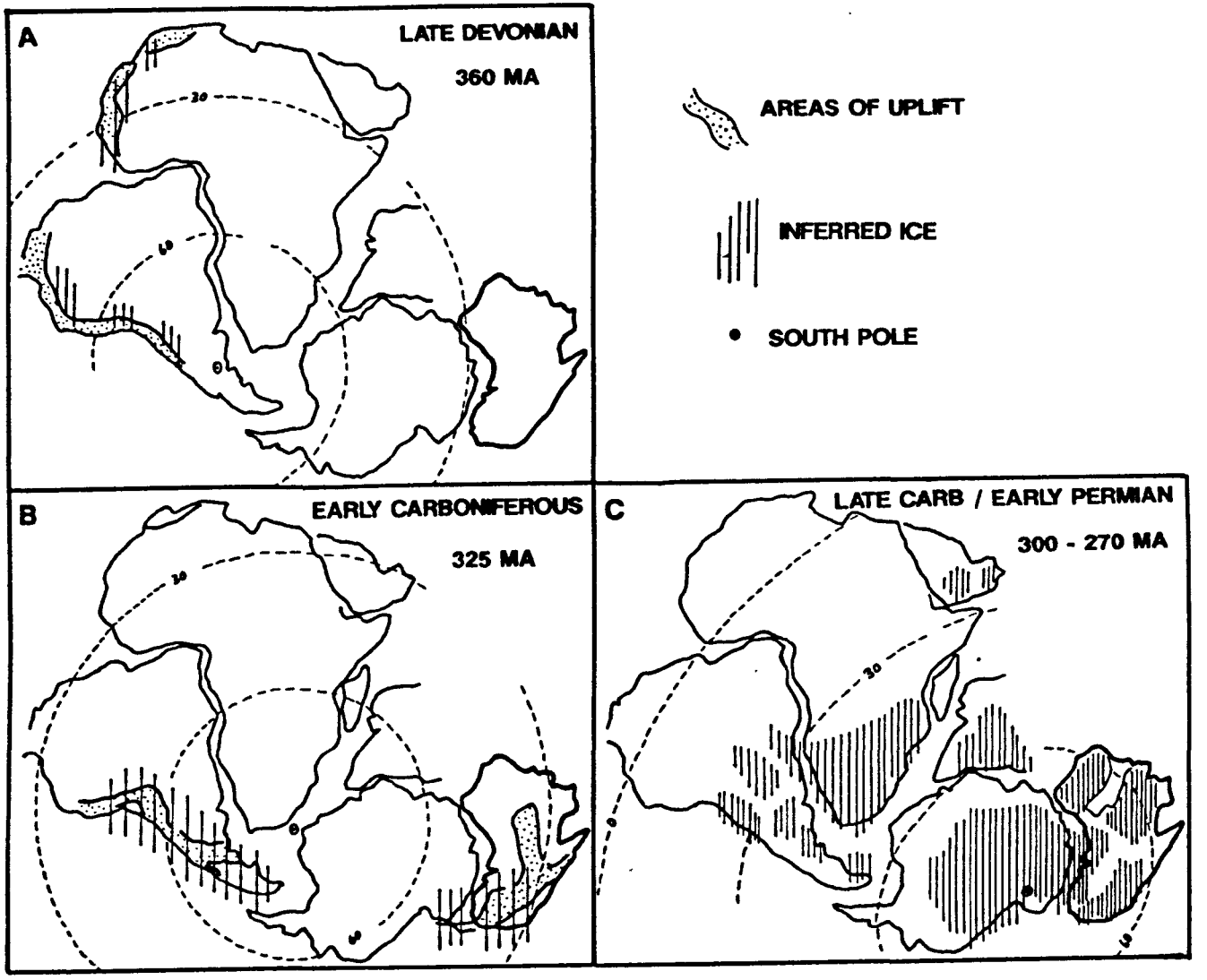

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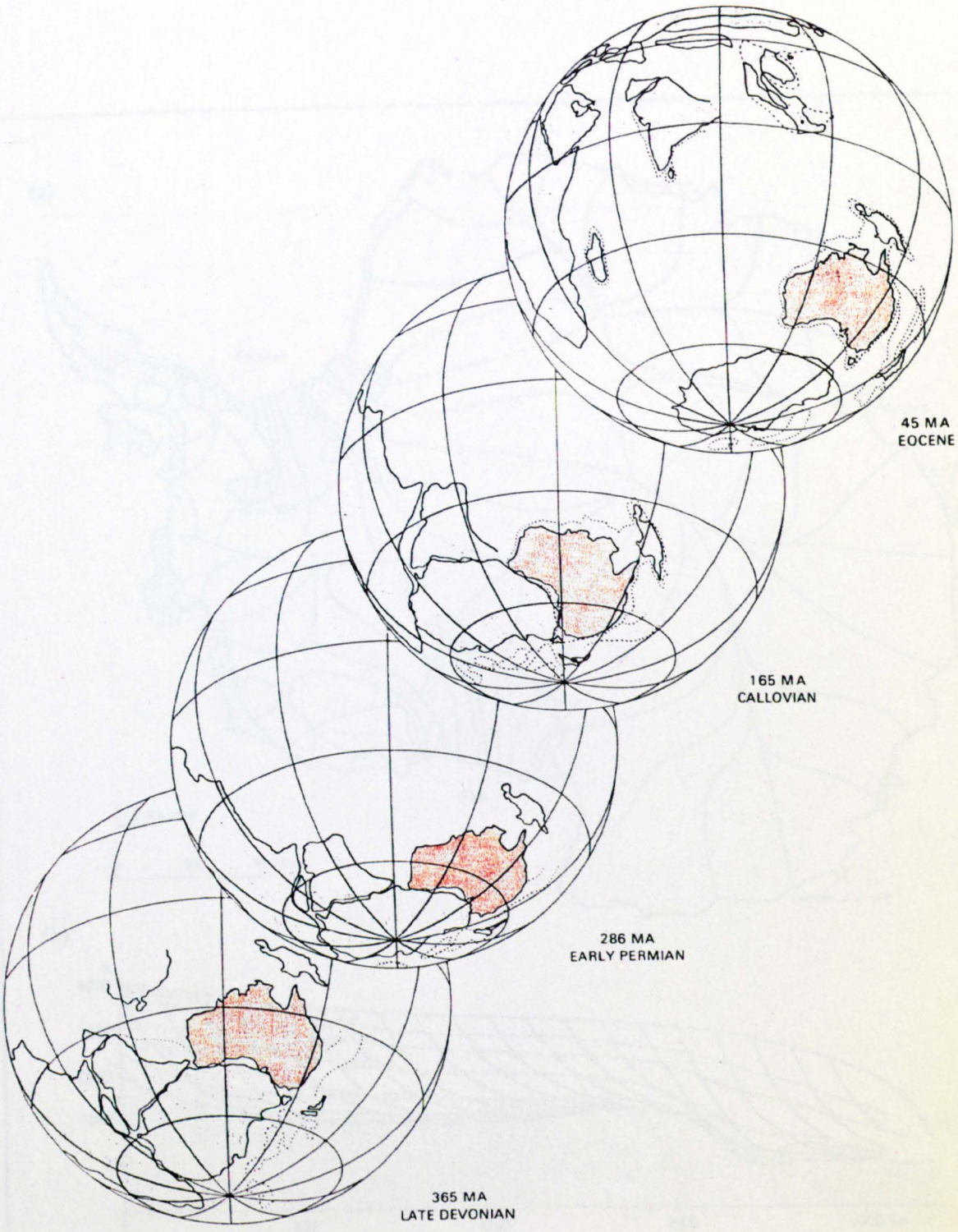

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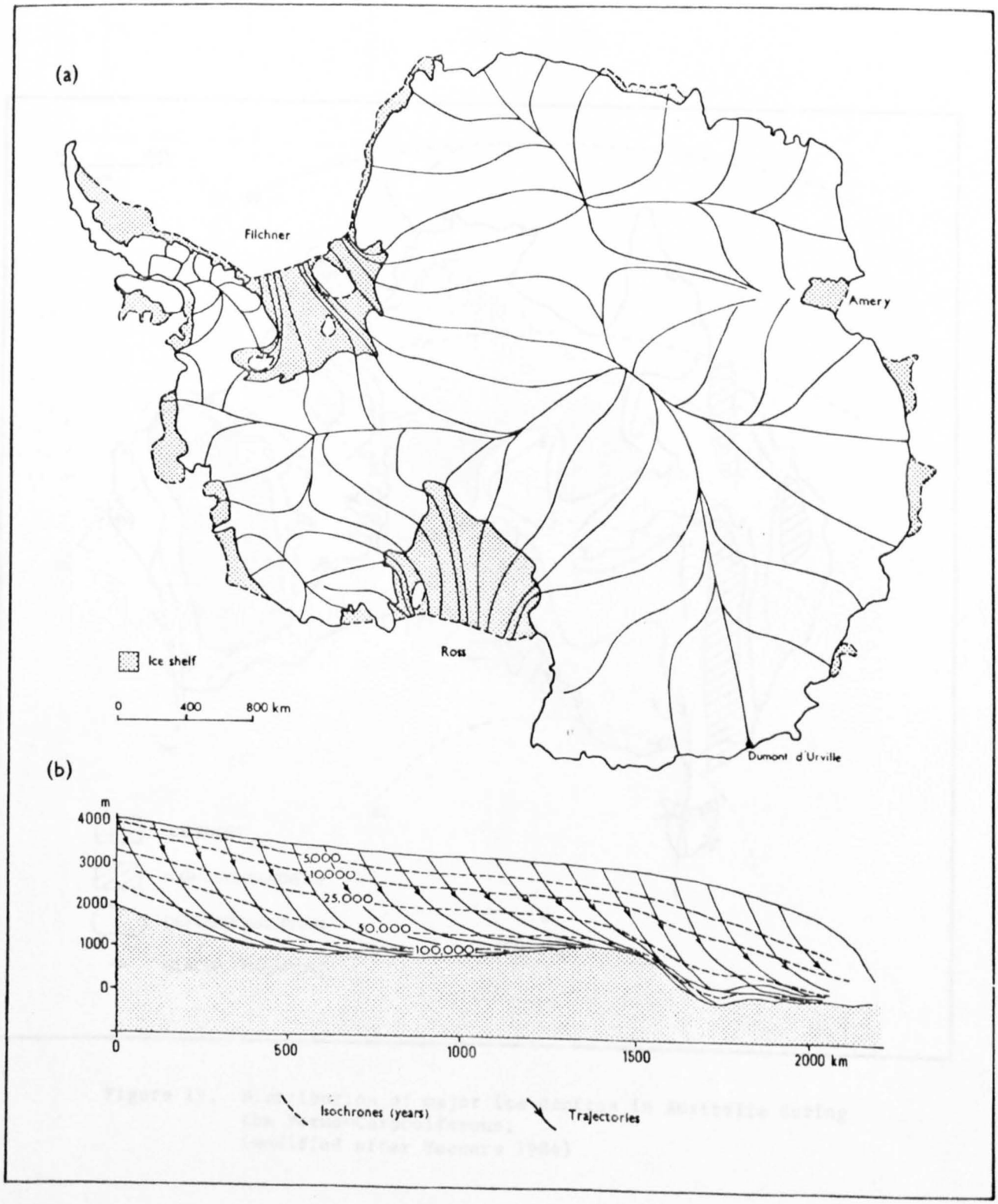

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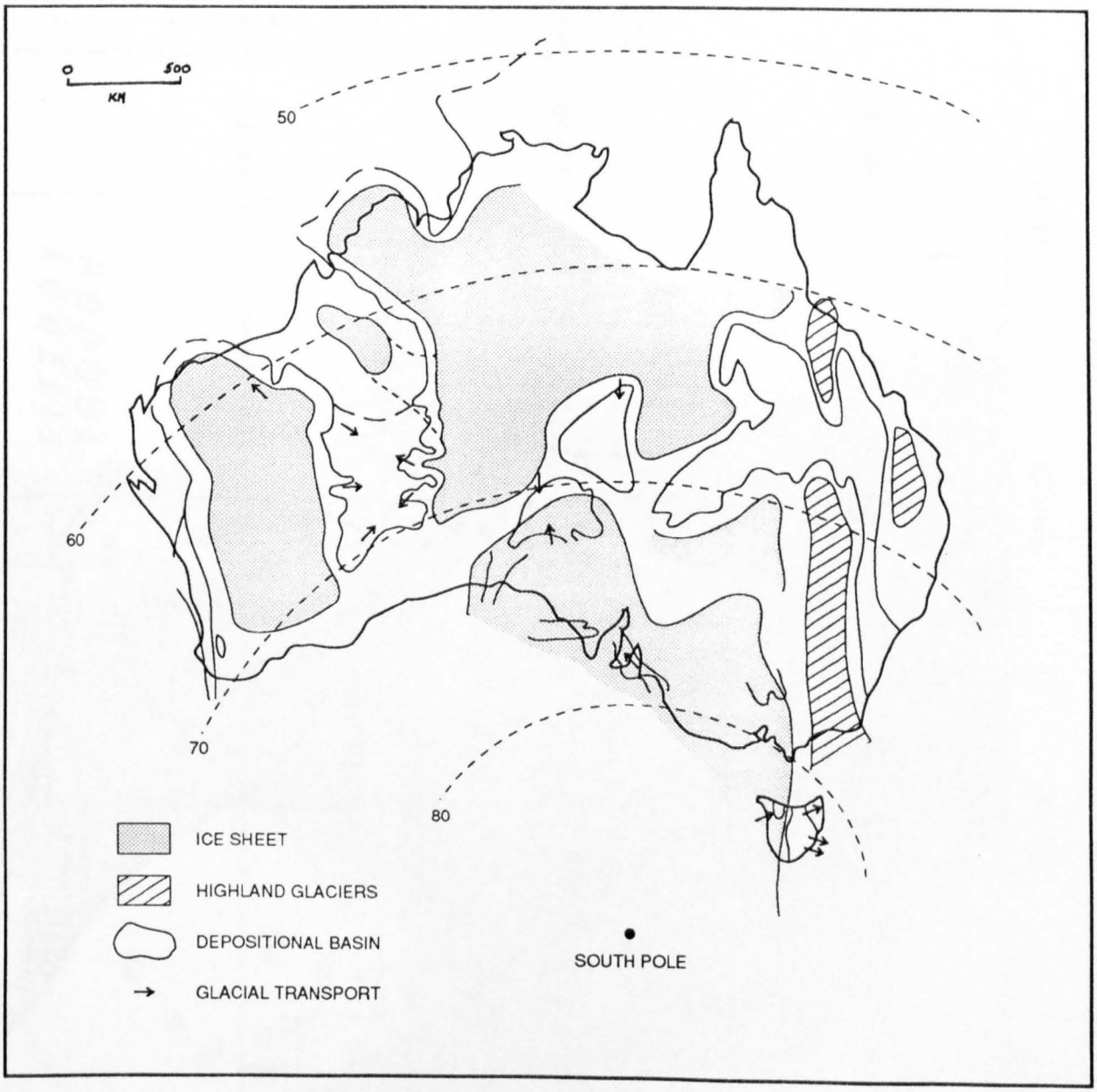

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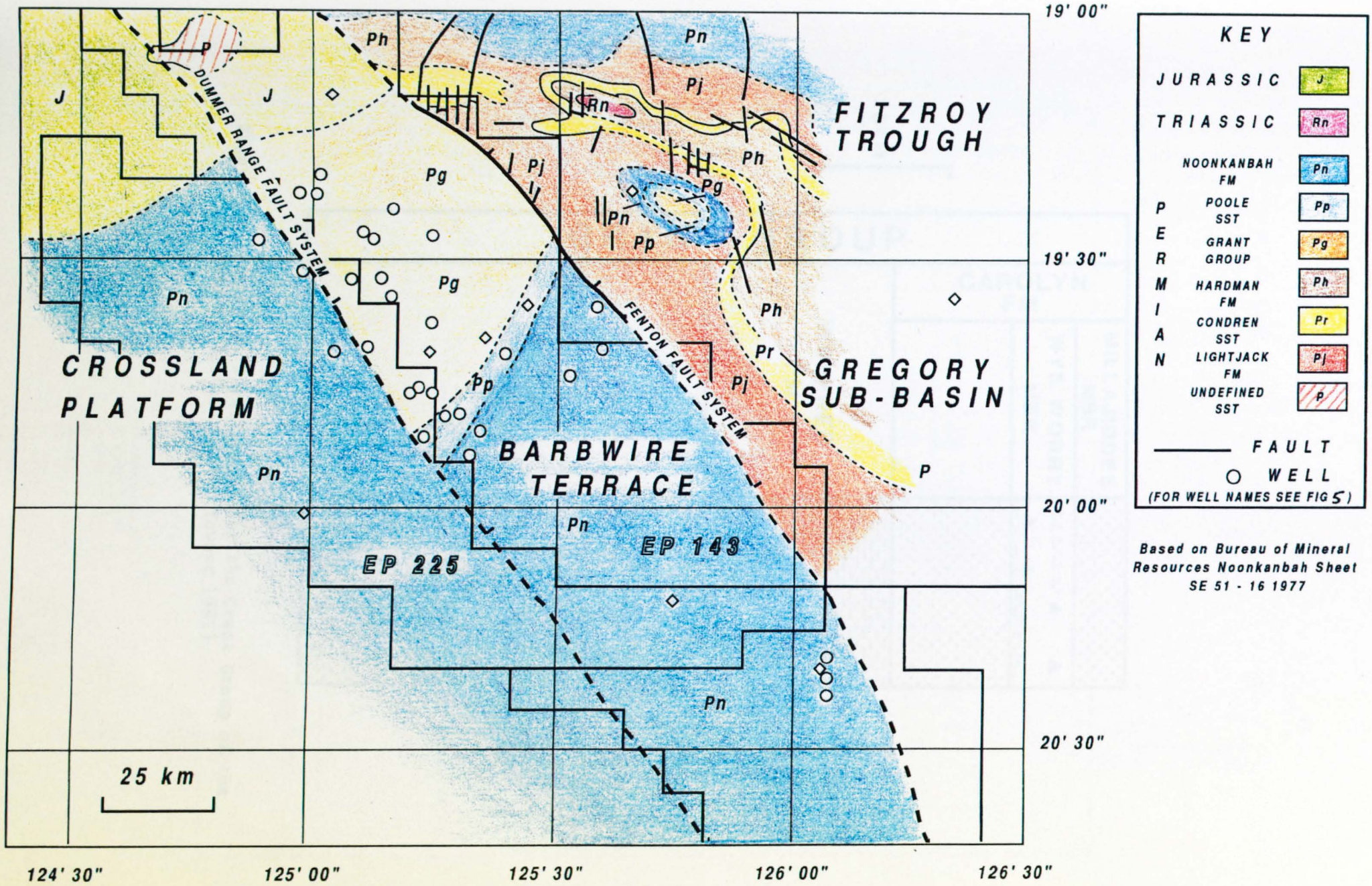

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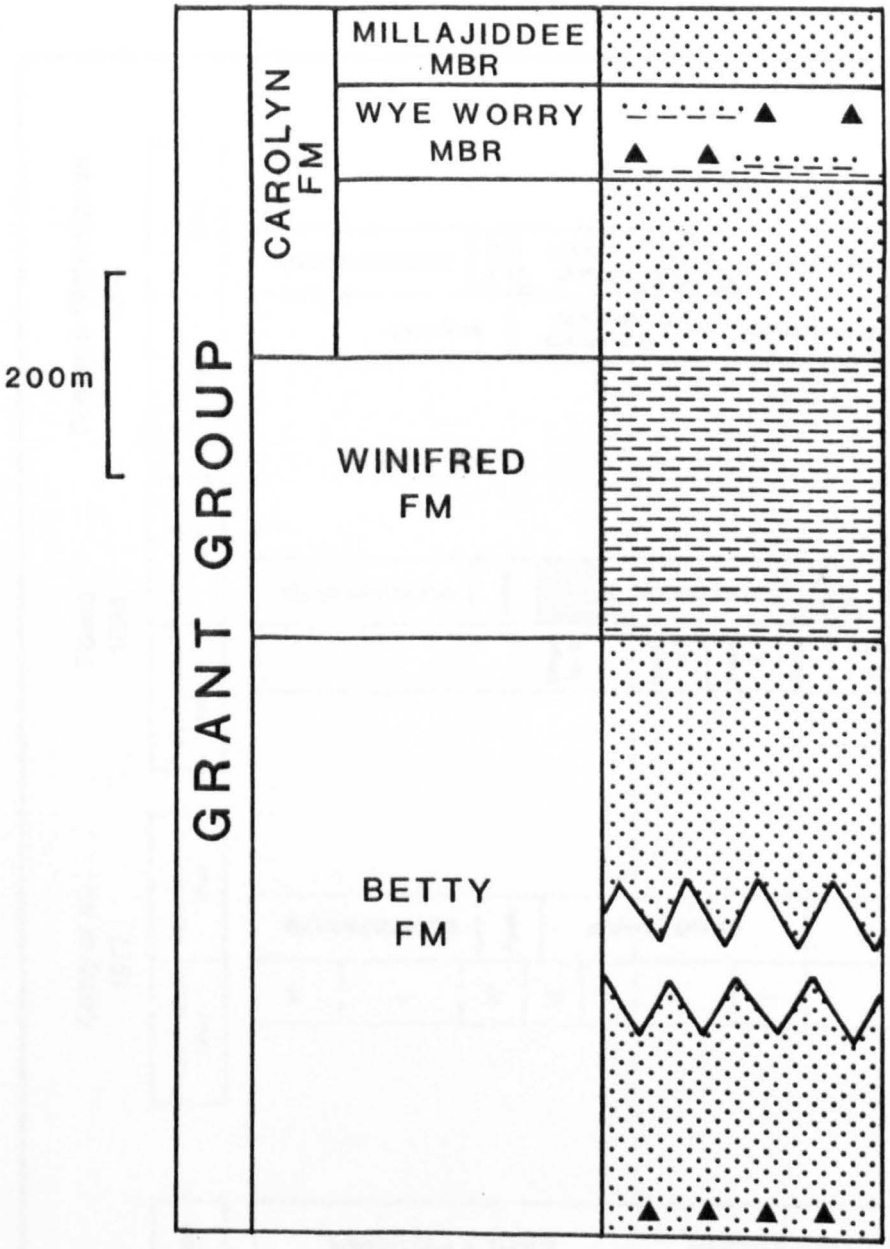

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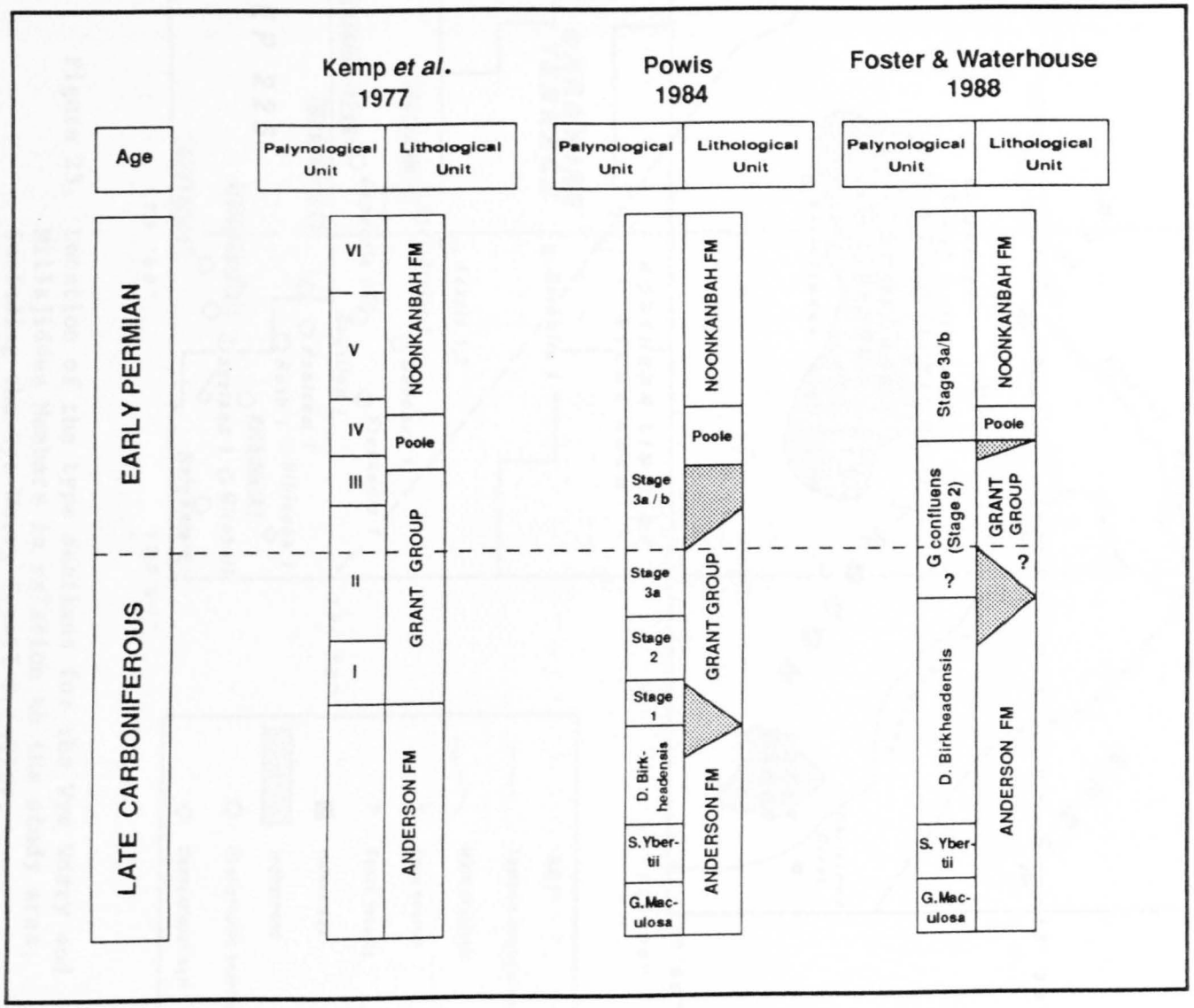

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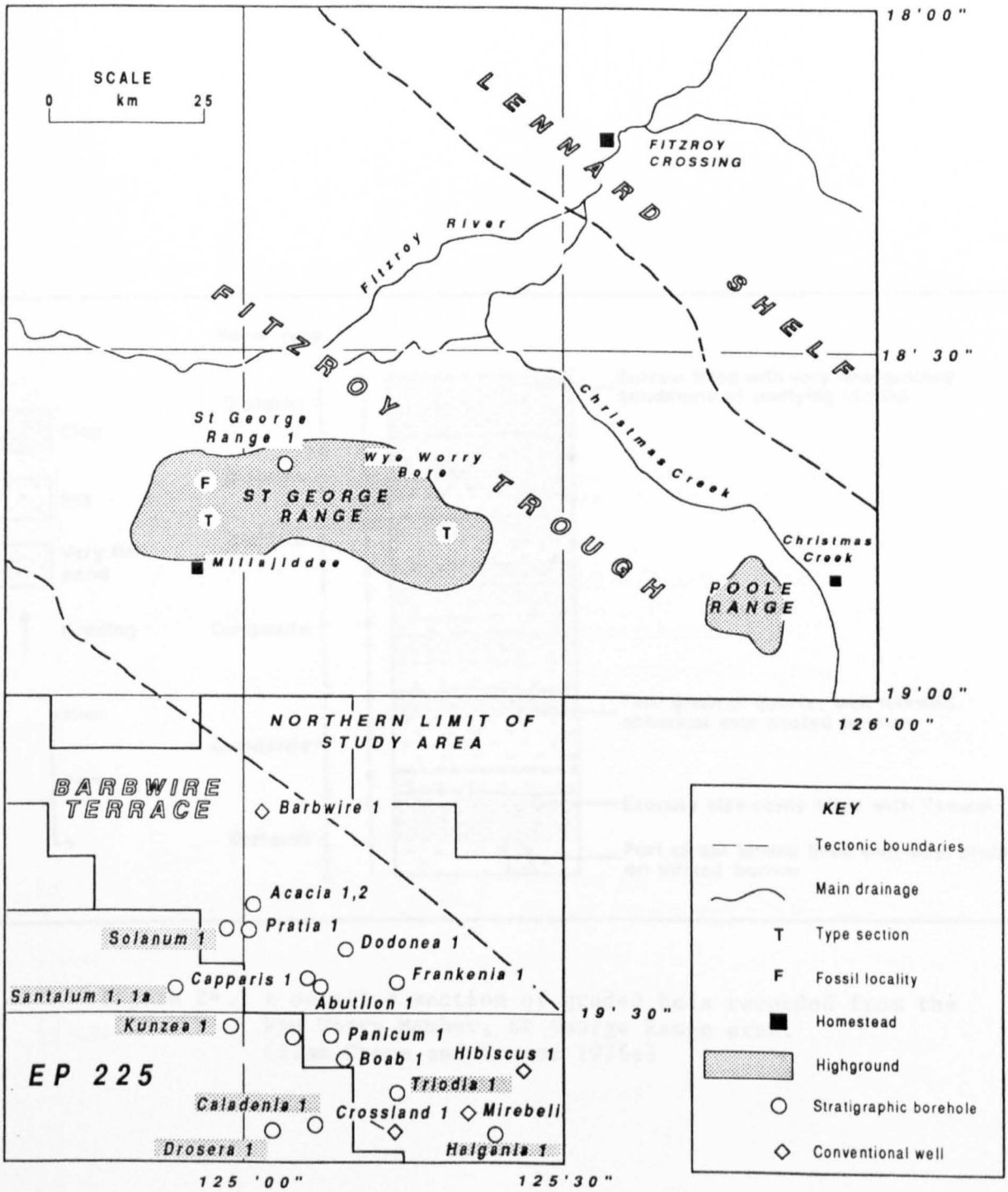

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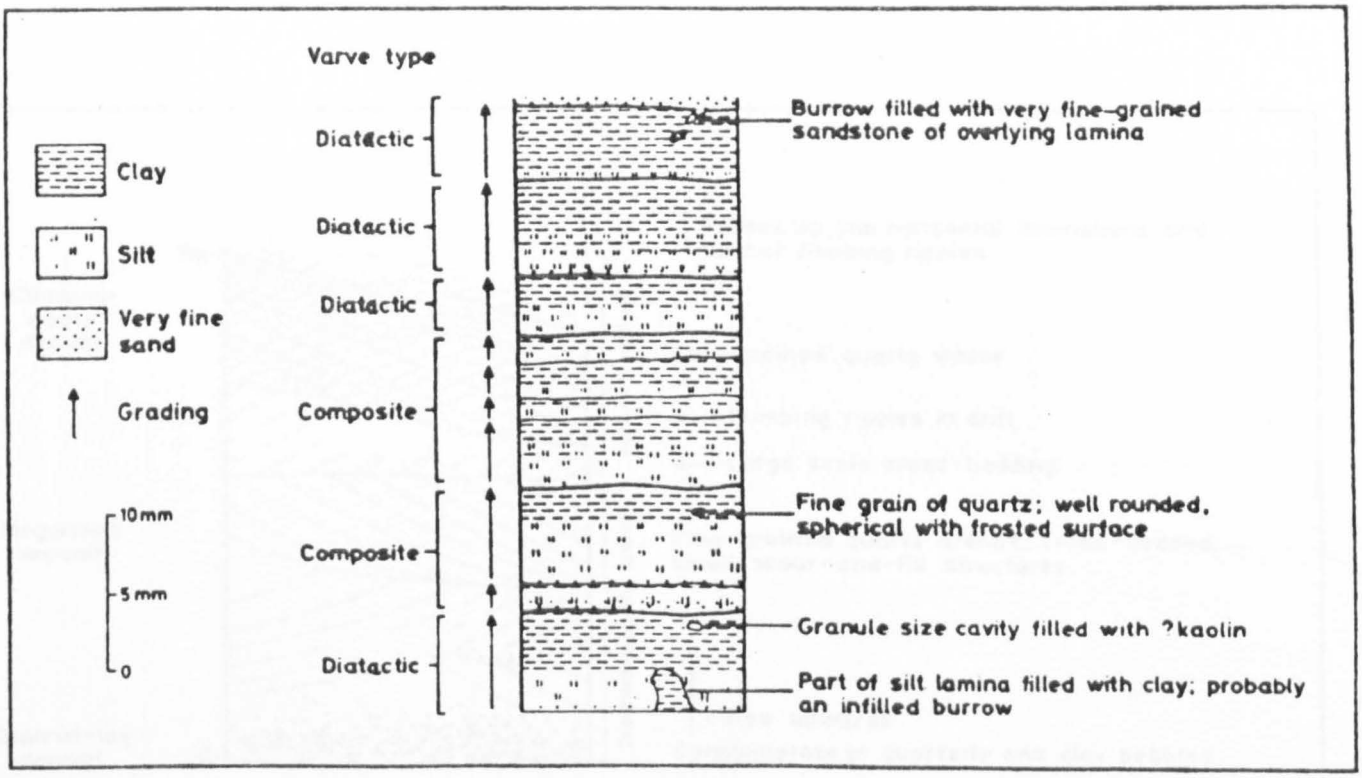

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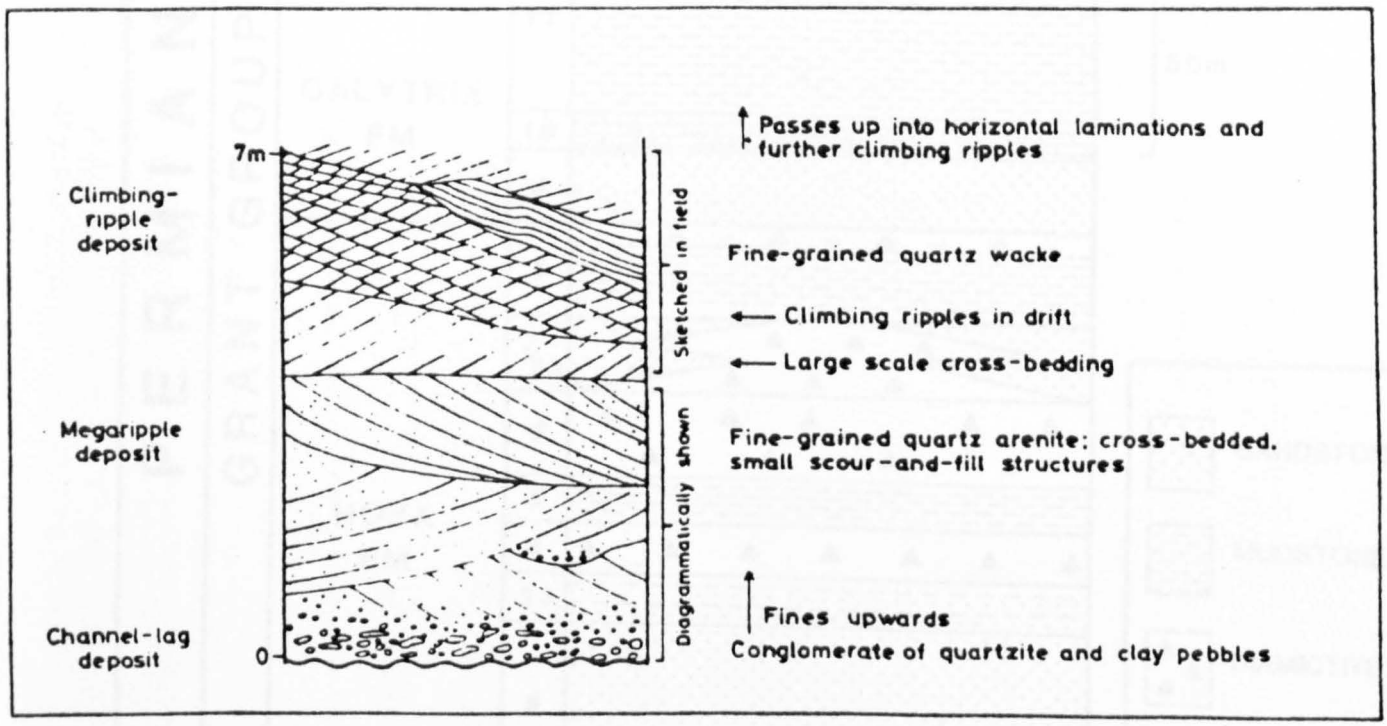

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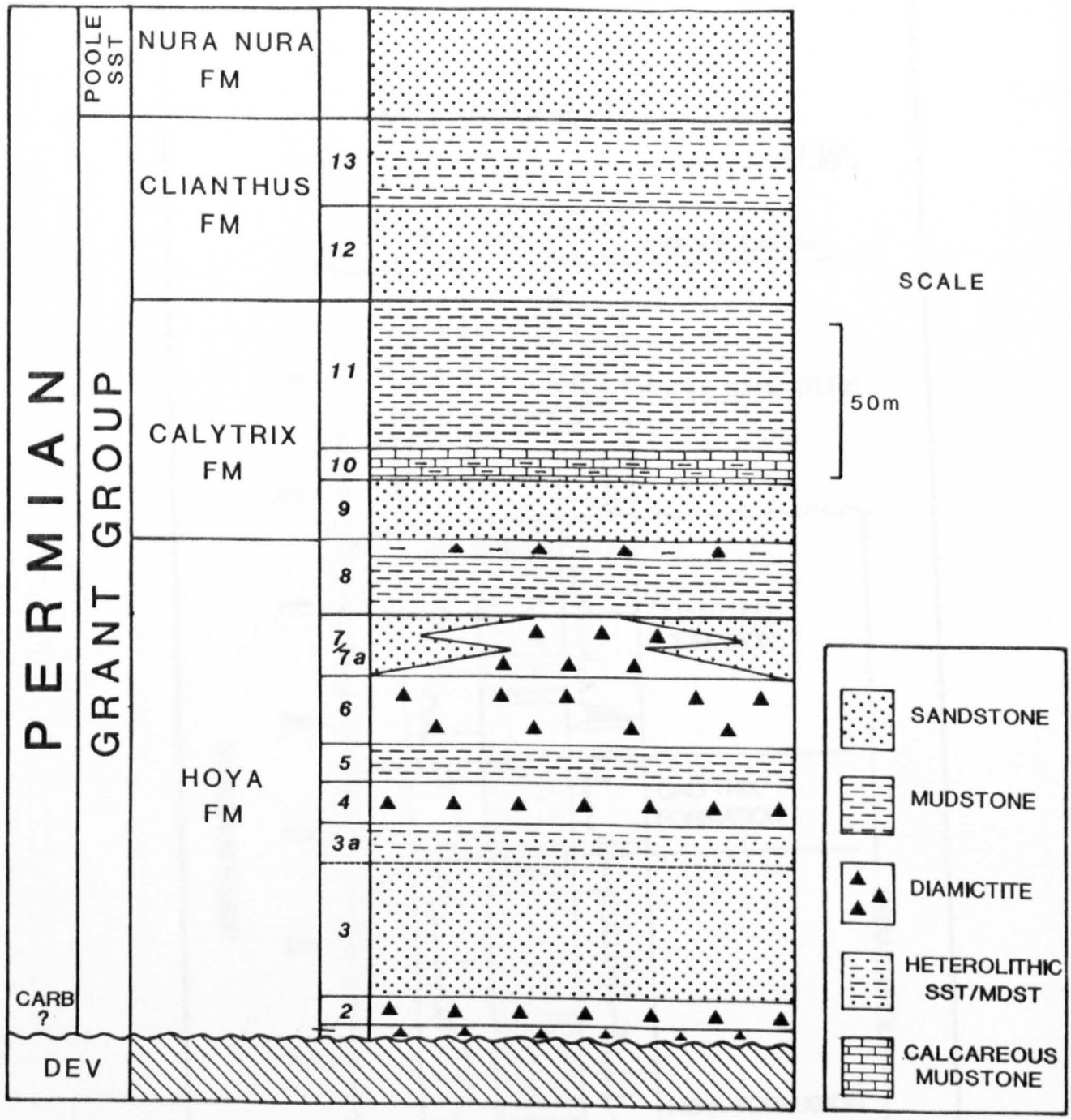


Figure 26. Stratigraphic Framework of the Grant Group on the Barbwire Terrace (Defined in this thesis).

STRATIGRAPHIC CORRELATION 1

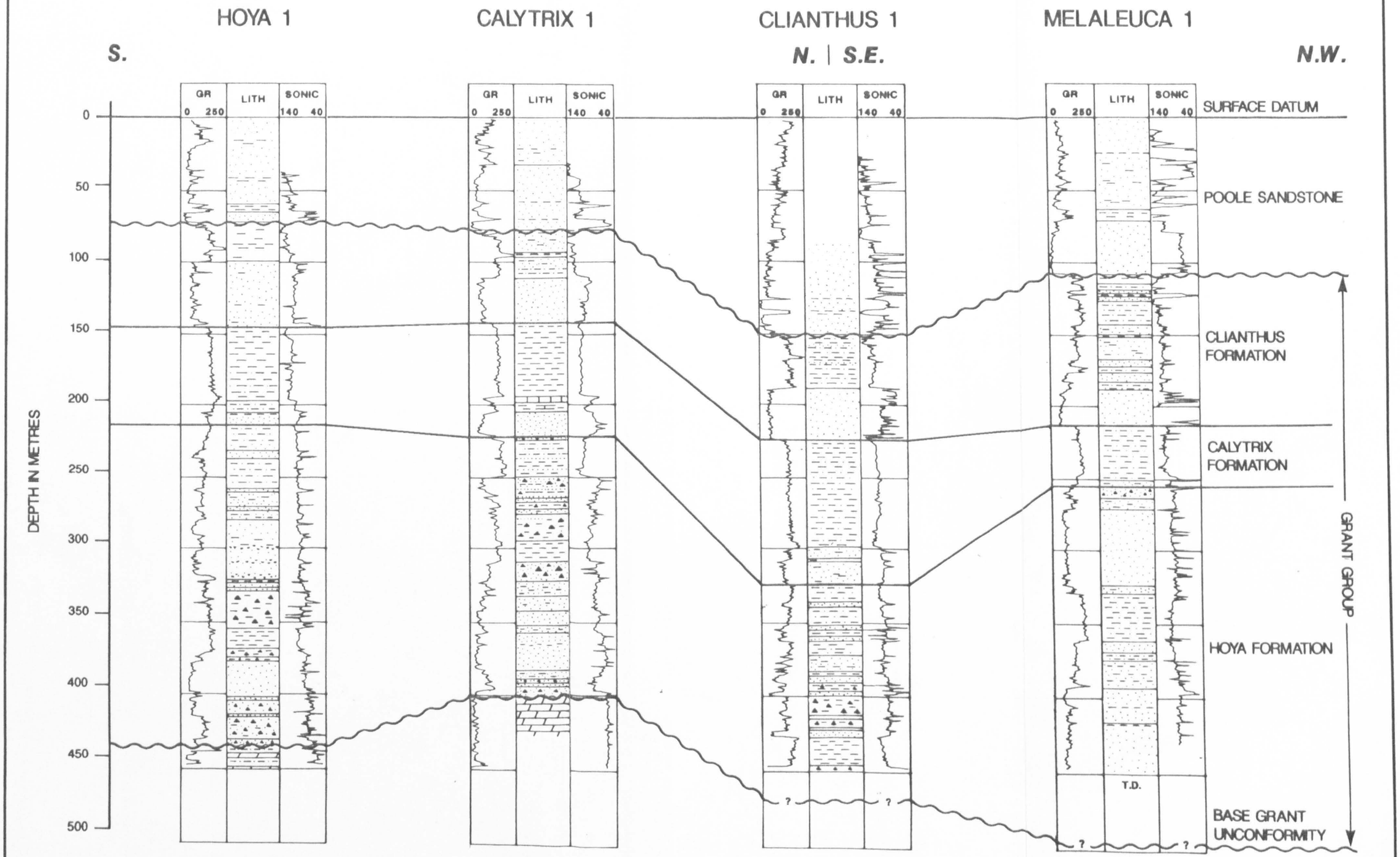


Figure 27. Stratigraphic correlation between Hoya 1, Calytrix 1, Clianthus 1 and Melaleuca 1.

STRATIGRAPHIC CORRELATION 2

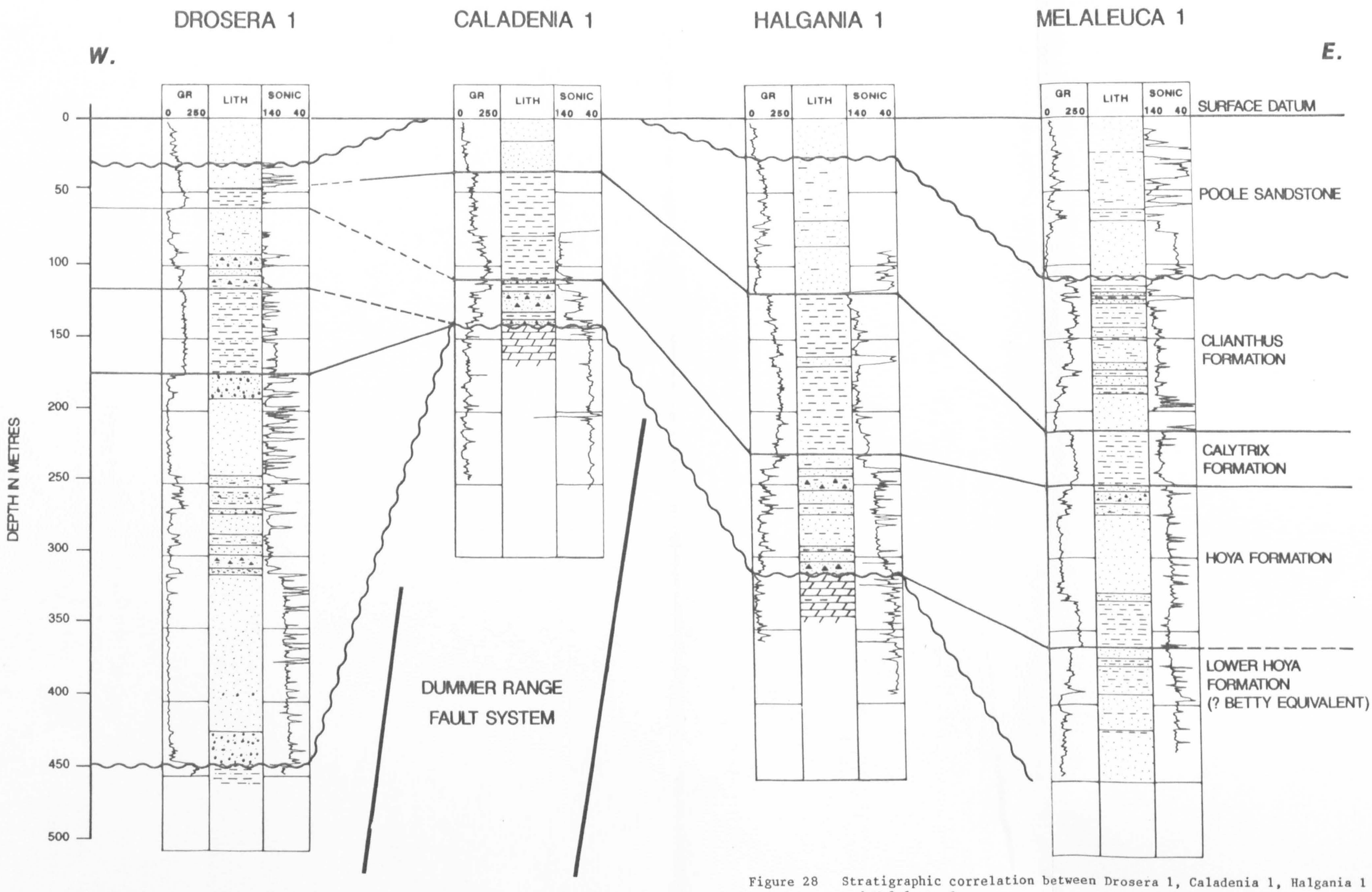
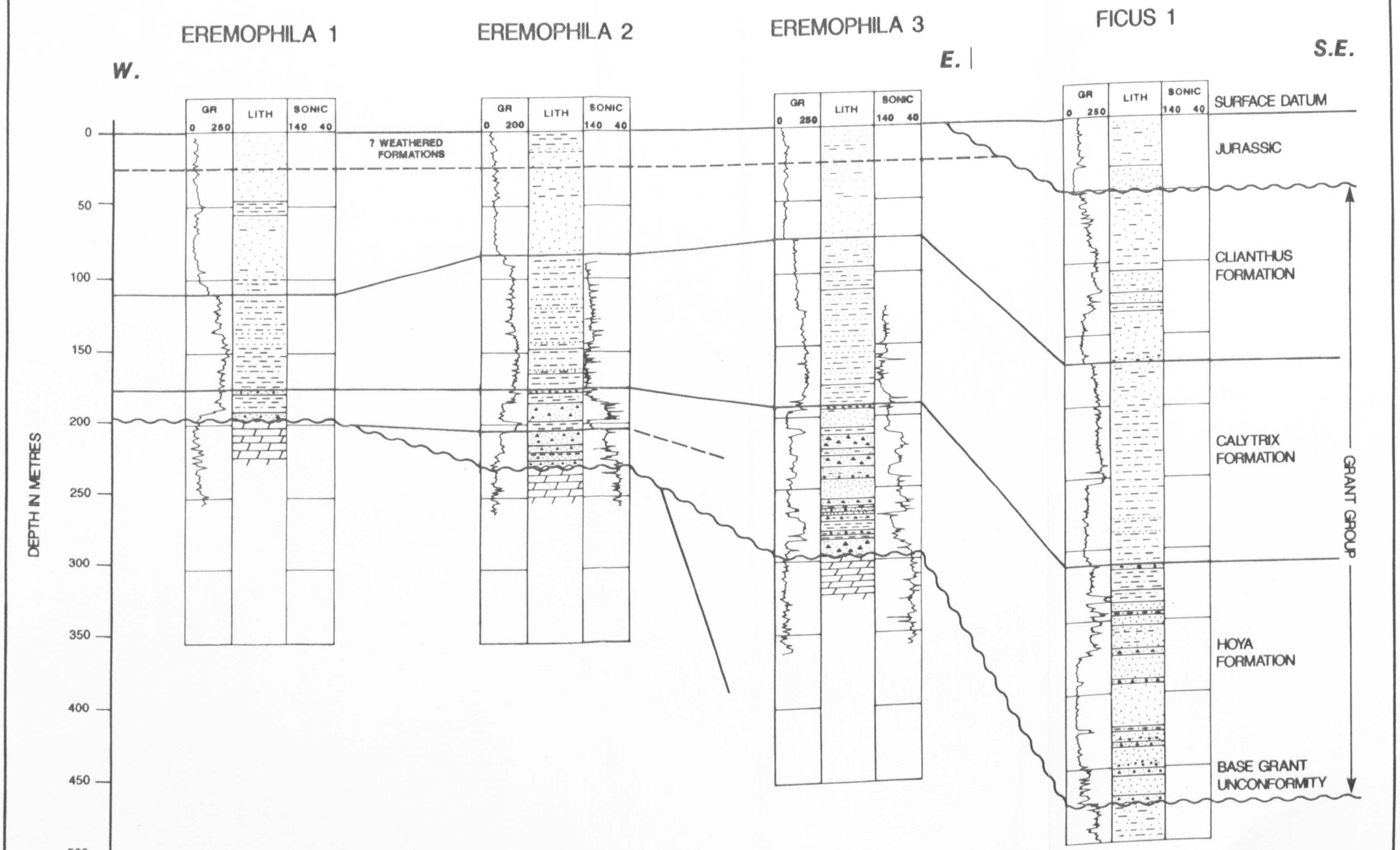


Figure 28 Stratigraphic correlation between Drosera 1, Caladenia 1, Halgania 1 and Melaleuca 1

STRATIGRAPHIC CORRELATION 3



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STRATIGRAPHIC CORRELATION 4

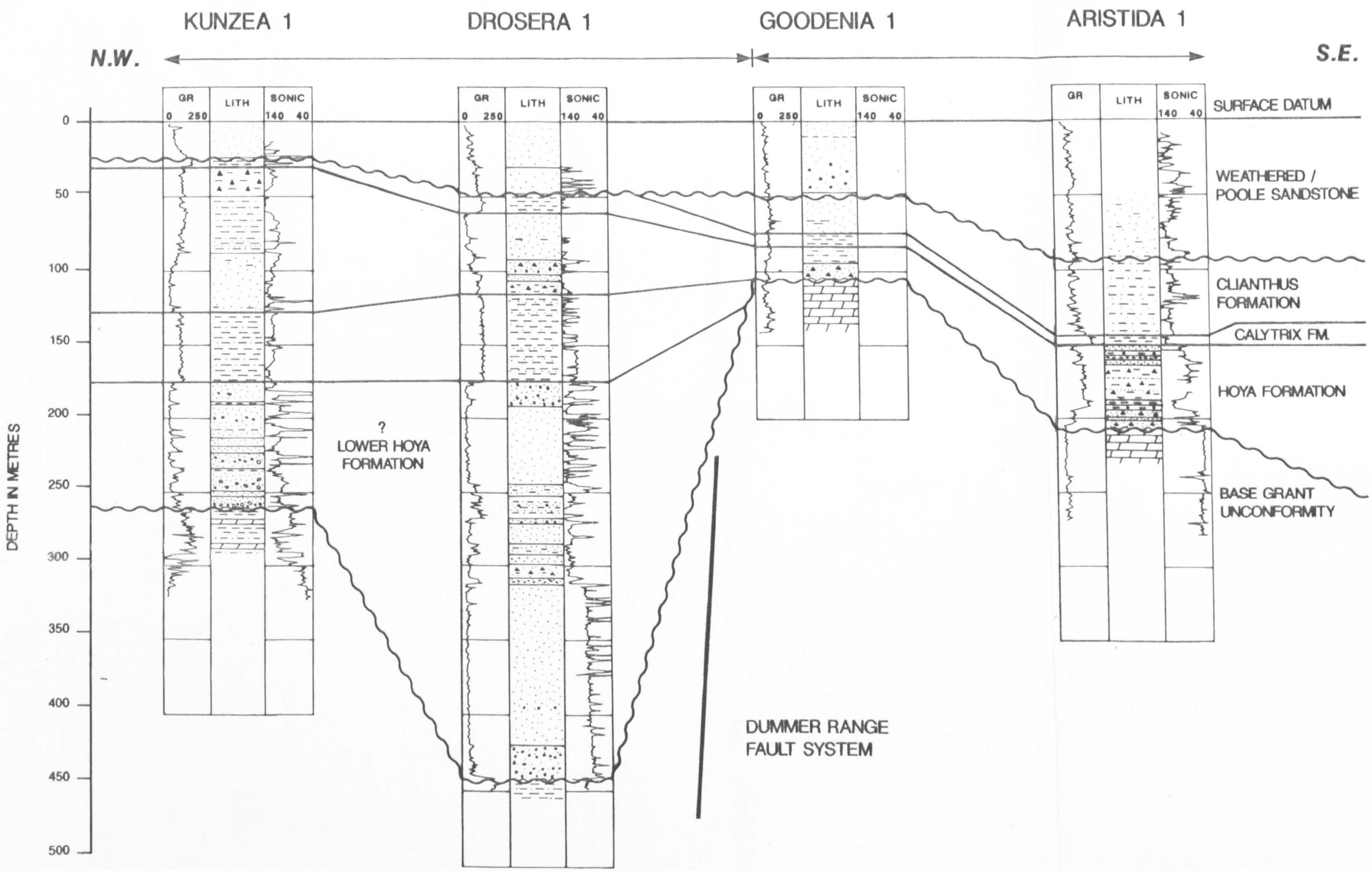


Figure 30 Stratigraphic correlation between Kunzea 1, Drosera 1, Goodenia 1 and Aristida 1A.

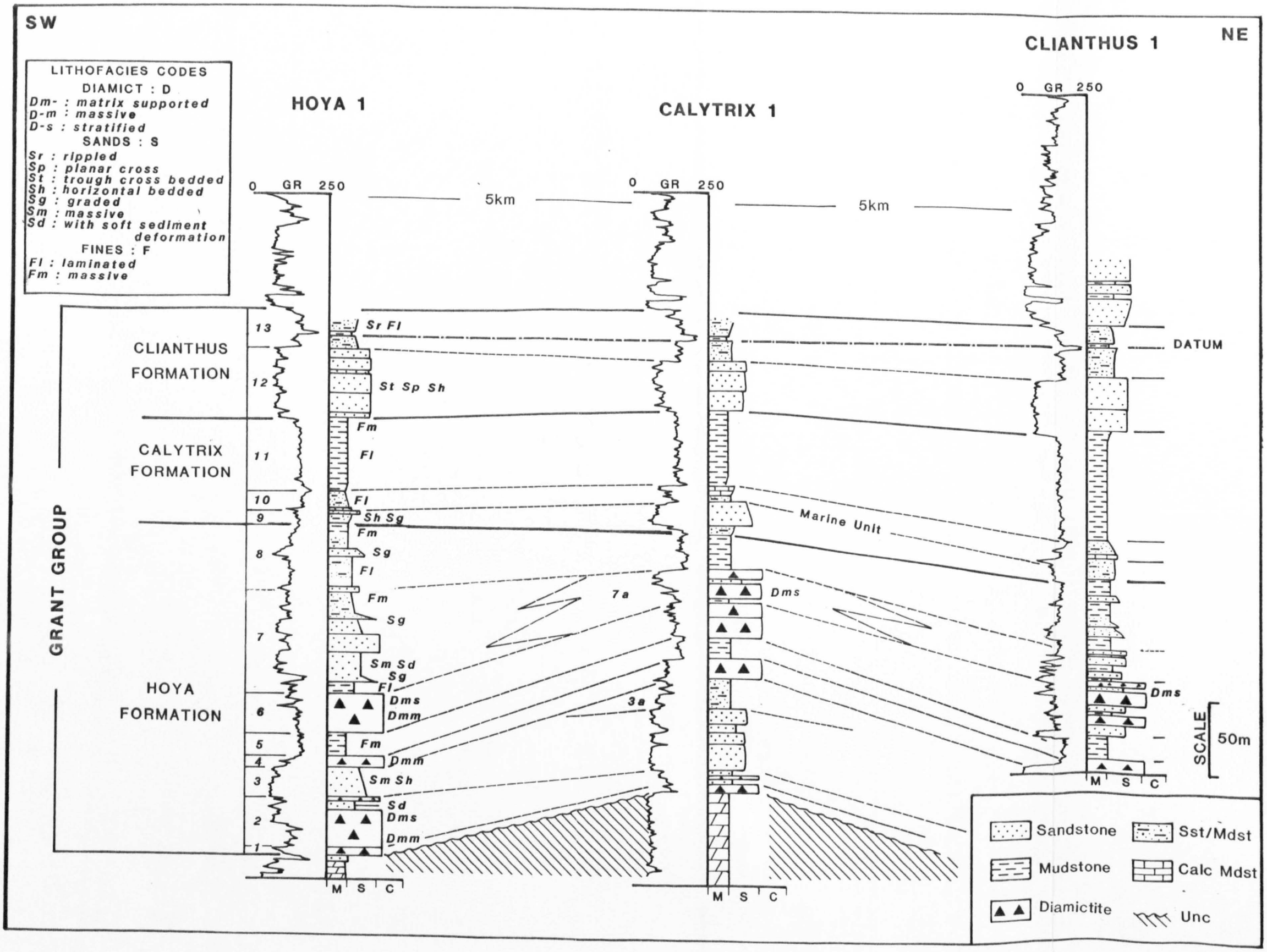


Figure 31. Detailed facies correlation of Hoya 1, Calytrix 1 and Clianthus 1

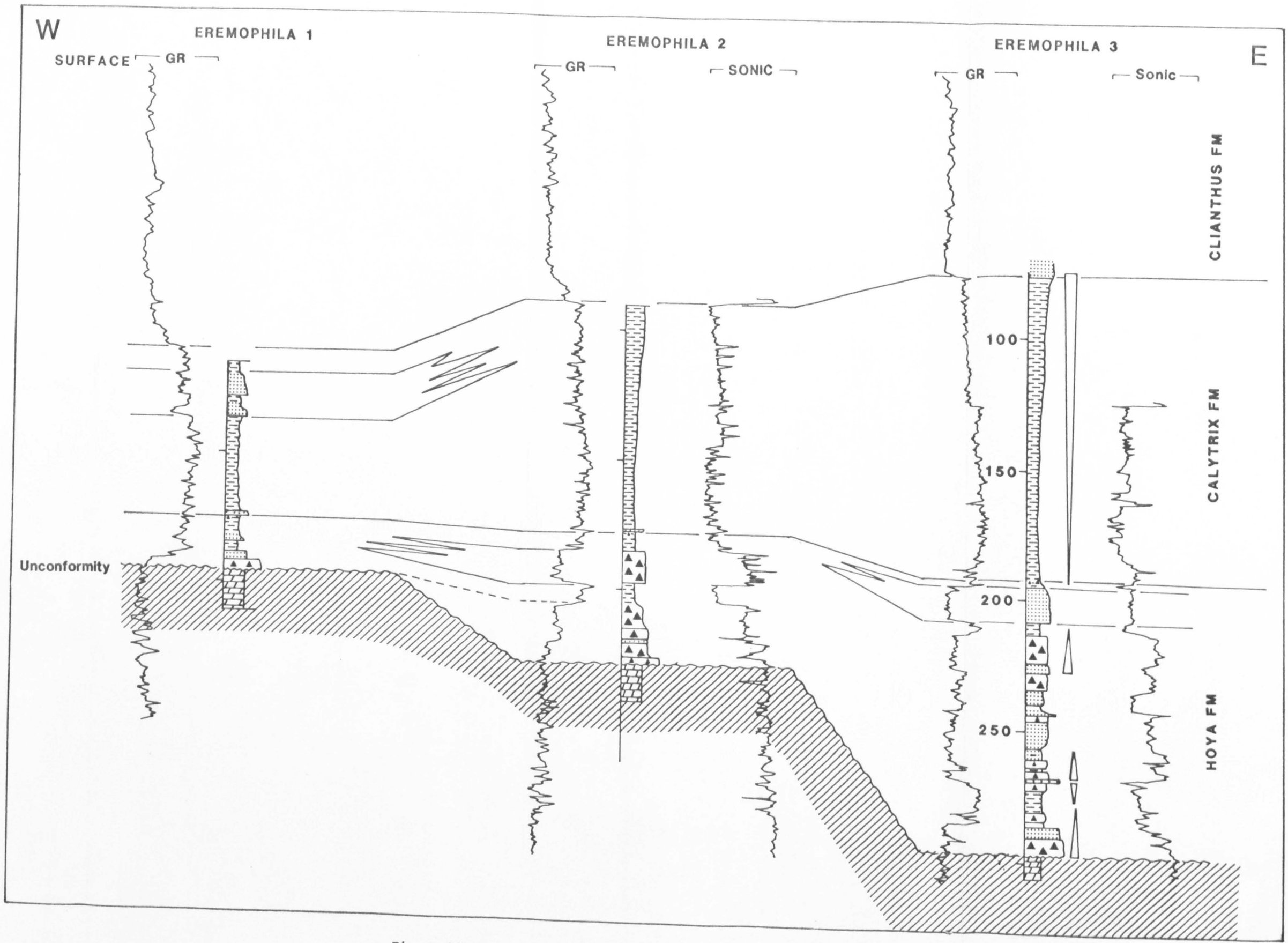


Figure 32. Detailed facies correlation of Eremophila 1, 2 and 3.

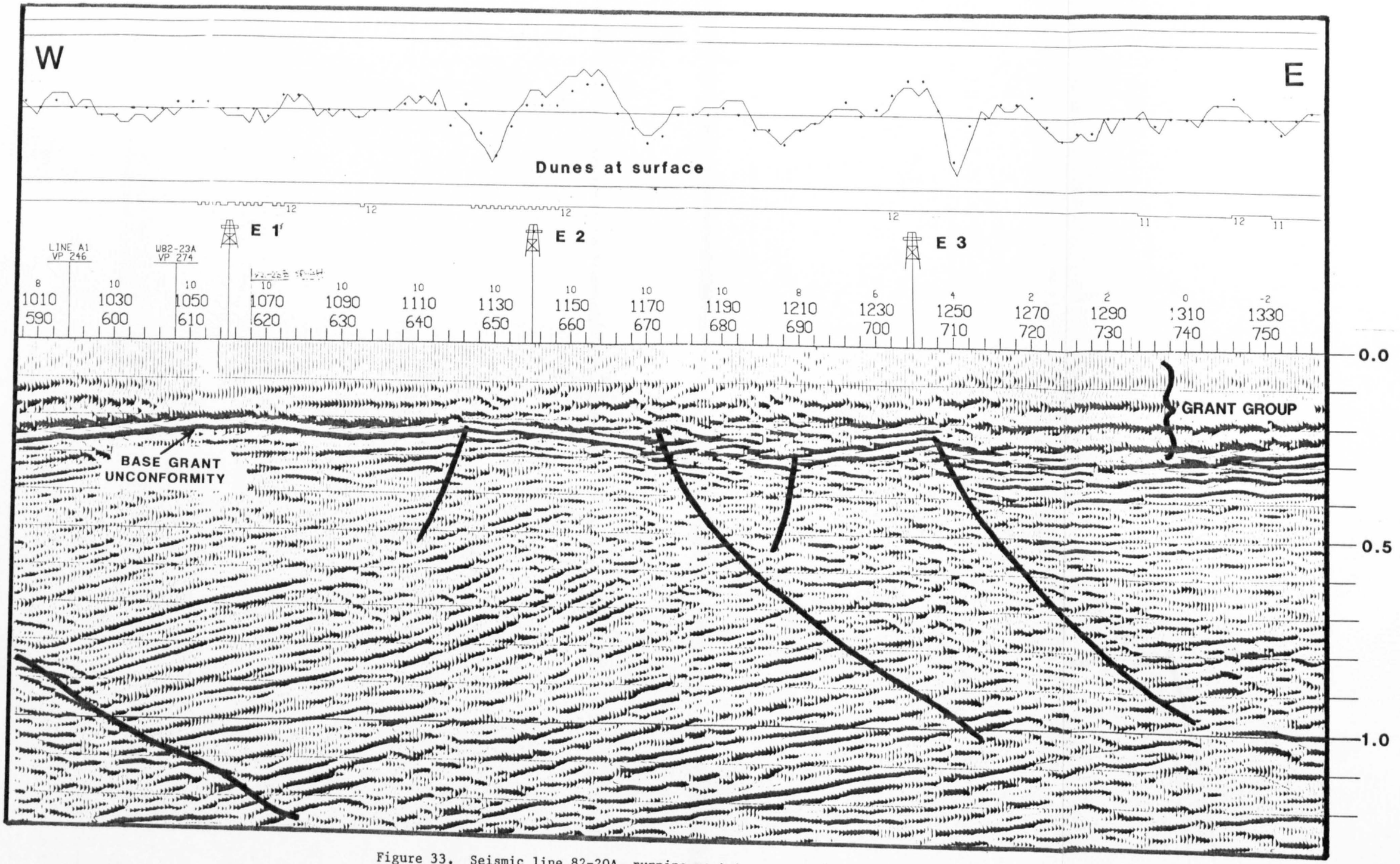


Figure 33. Seismic line 82-20A, running west to east, and controlled by Eremophila 1, 2 and 3. (for well correlation see Figure 32)

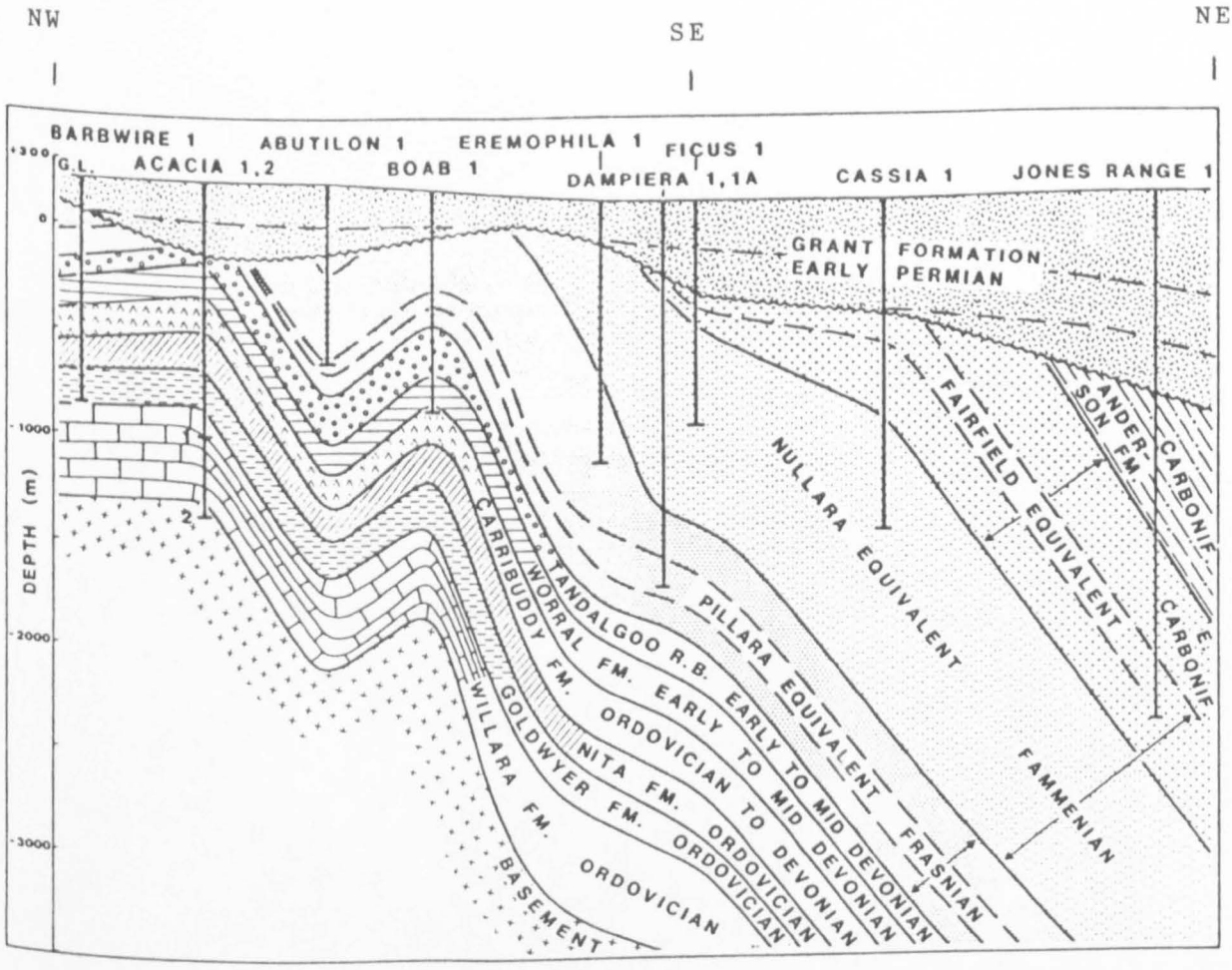


Figure 34. Diagrammatic cross section to illustrate the pre-Grant structure and the variability of subcropping formations on the Barbwire Terrace and Fitzroy Graben (From Ashton 1984).

(For well location see Figure 5)

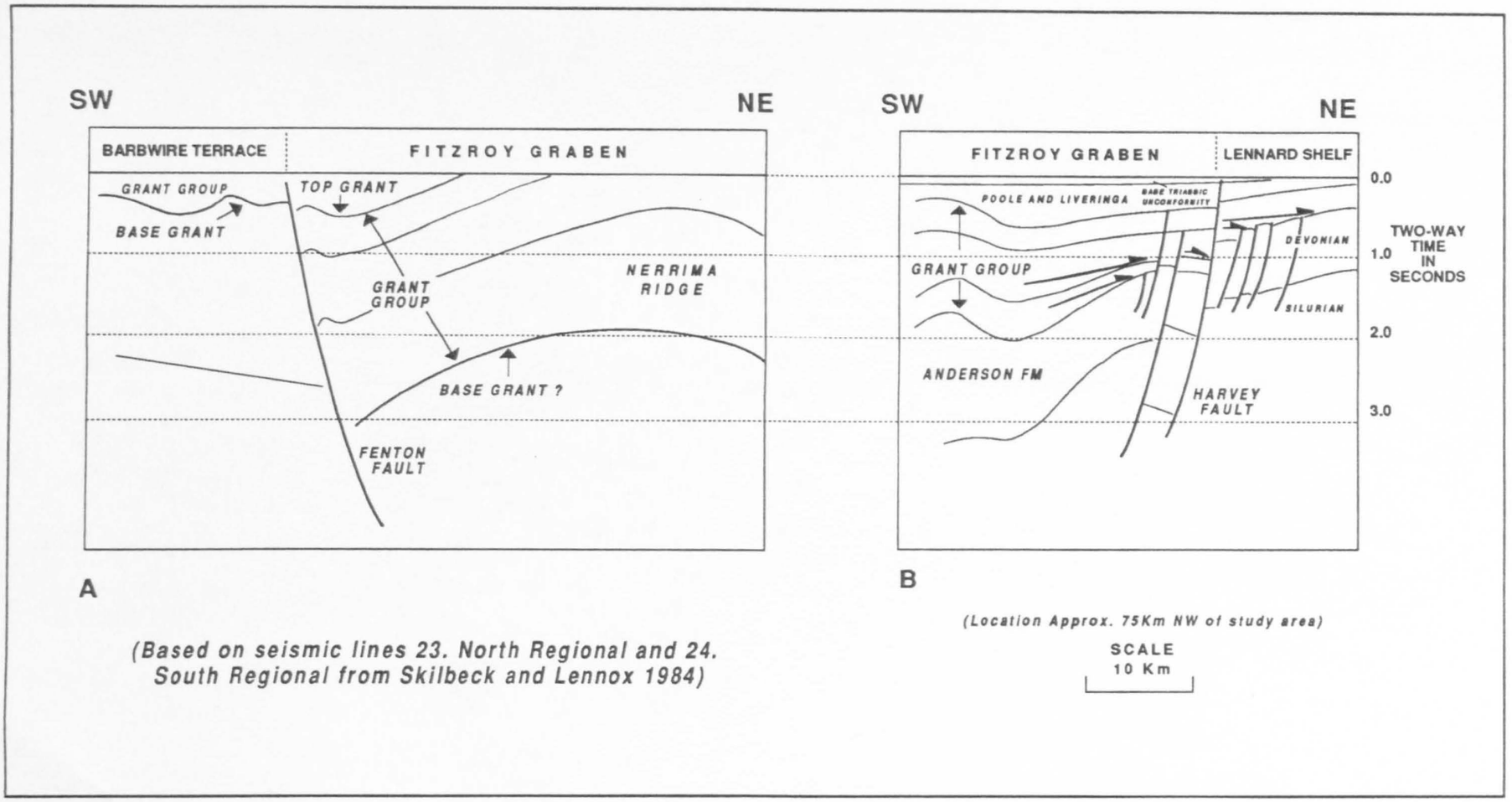


Figure 35. Interpretation of two regional seismic lines running SW to NE across the Fitzroy Graben. This illustrates a large anticline, interpreted to be analogous to the structure which results in exposure of the Grant Group in the St George Range.

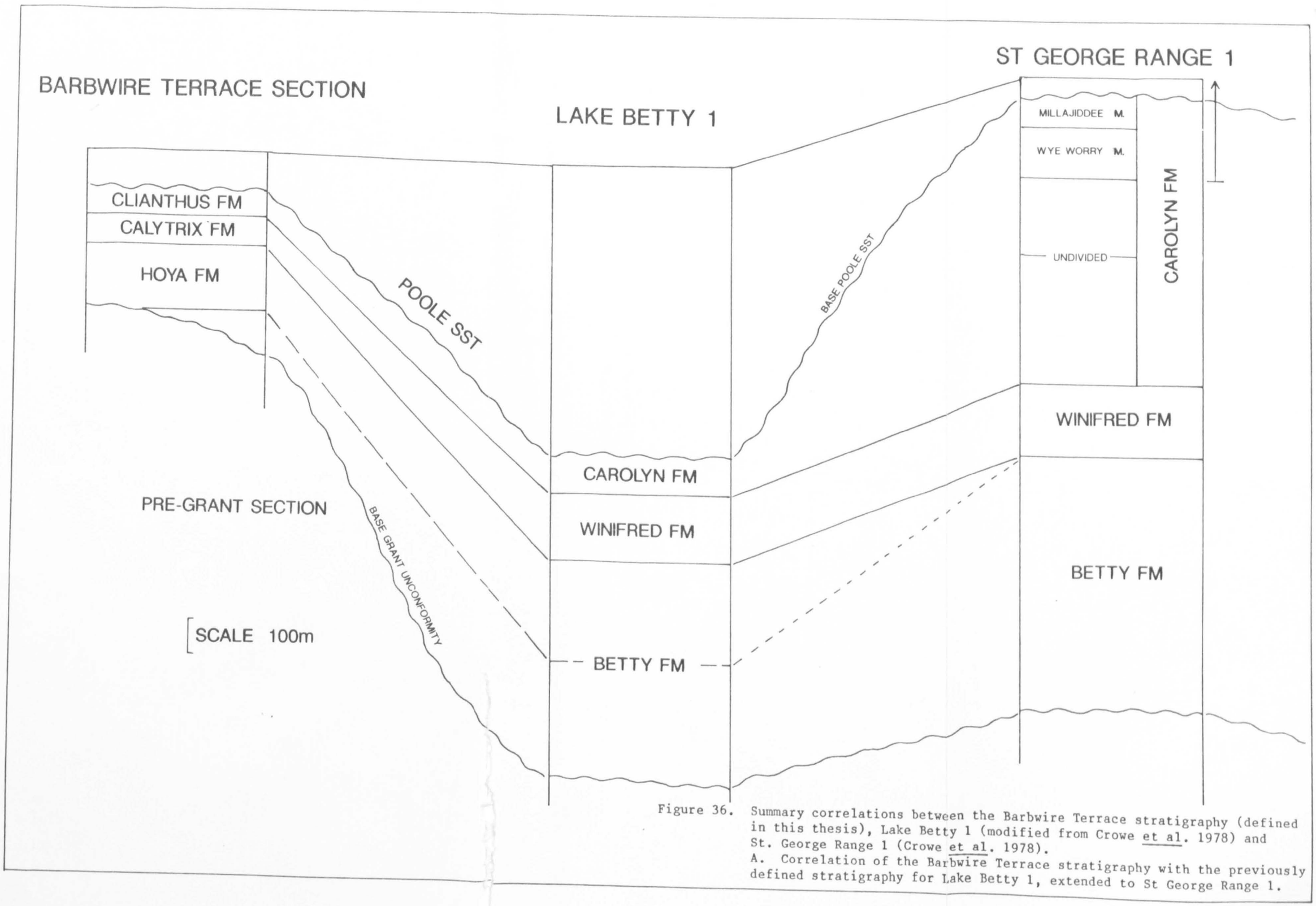


Figure 36. Summary correlations between the Barbwire Terrace stratigraphy (defined in this thesis), Lake Betty 1 (modified from Crowe et al. 1978) and St. George Range 1 (Crowe et al. 1978).
A. Correlation of the Barbwire Terrace stratigraphy with the previously defined stratigraphy for Lake Betty 1, extended to St George Range 1.

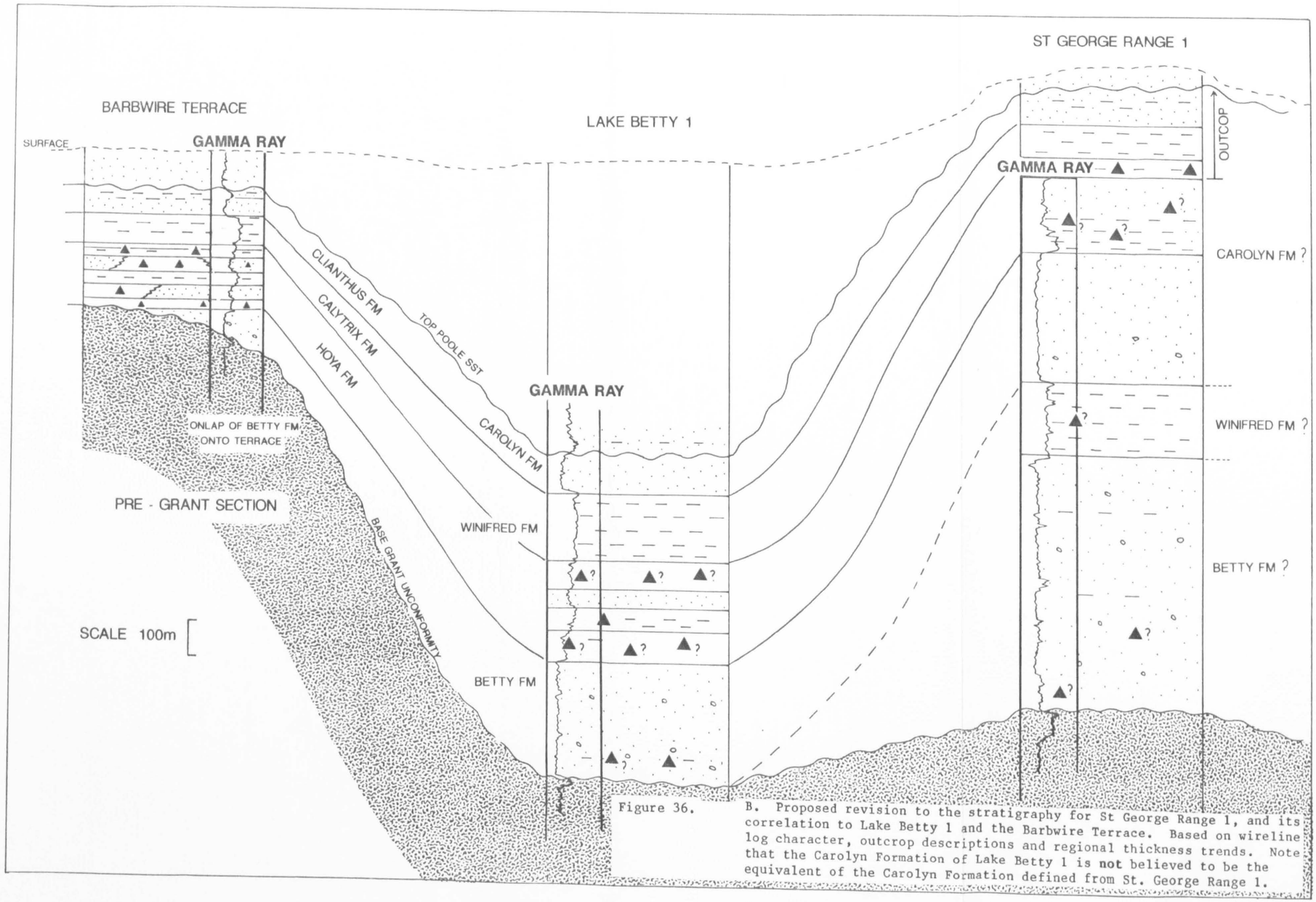


Figure 36. B. Proposed revision to the stratigraphy for St George Range 1, and its correlation to Lake Betty 1 and the Barbwire Terrace. Based on wireline log character, outcrop descriptions and regional thickness trends. Note that the Carolyn Formation of Lake Betty 1 is **not** believed to be the equivalent of the Carolyn Formation defined from St. George Range 1.

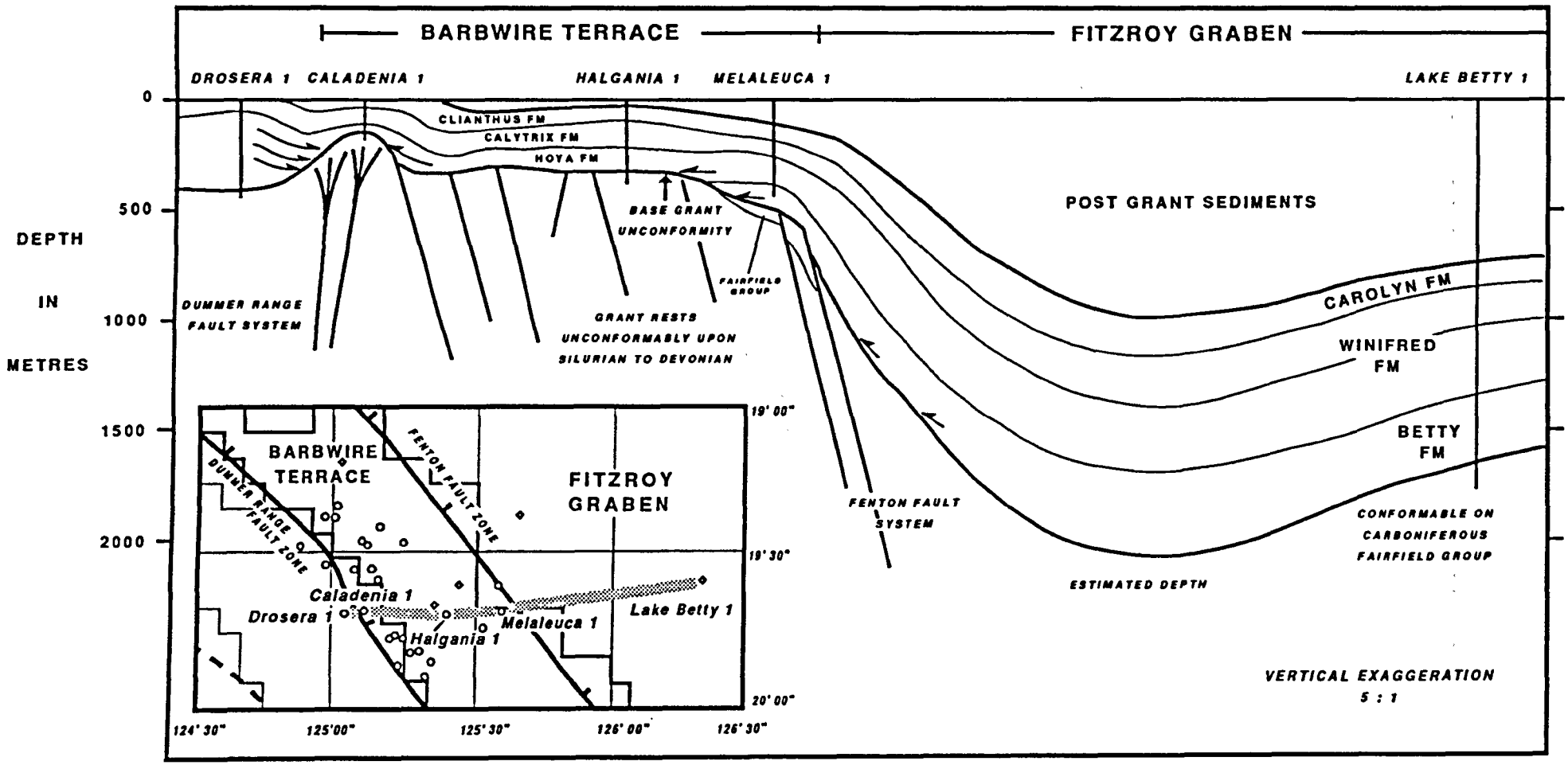
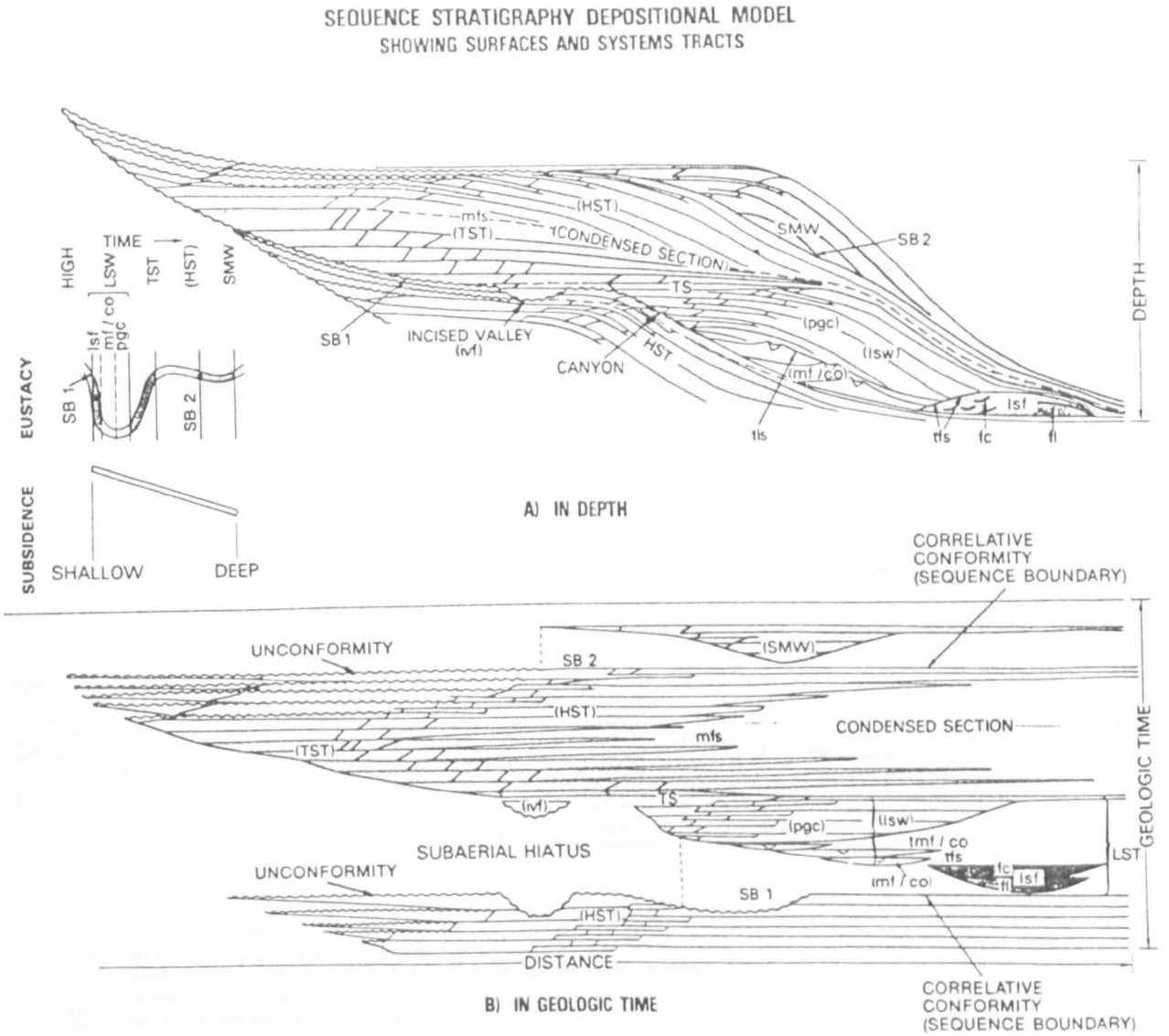


Figure 37. Correlation between the Barbwire Terrace Grant Group stratigraphy defined in this thesis and the published stratigraphy for Lake Betty 1. (Lake Betty 1 stratigraphy modified from Crowe et al. 1978)



LEGEND

SURFACES

(SB) SEQUENCE BOUNDARIES
- (SB 1) = TYPE 1
- (SB 2) = TYPE 2

(DLS) DOWNLAP SURFACES
- (mfs) = maximum flooding surface
- (tfs) = top fan surface
- (tmf / co) = top mass flow / channel overbank

(TS) TRANSGRESSIVE SURFACE
- (First flooding surface above maximum regression)

SYSTEMS TRACTS

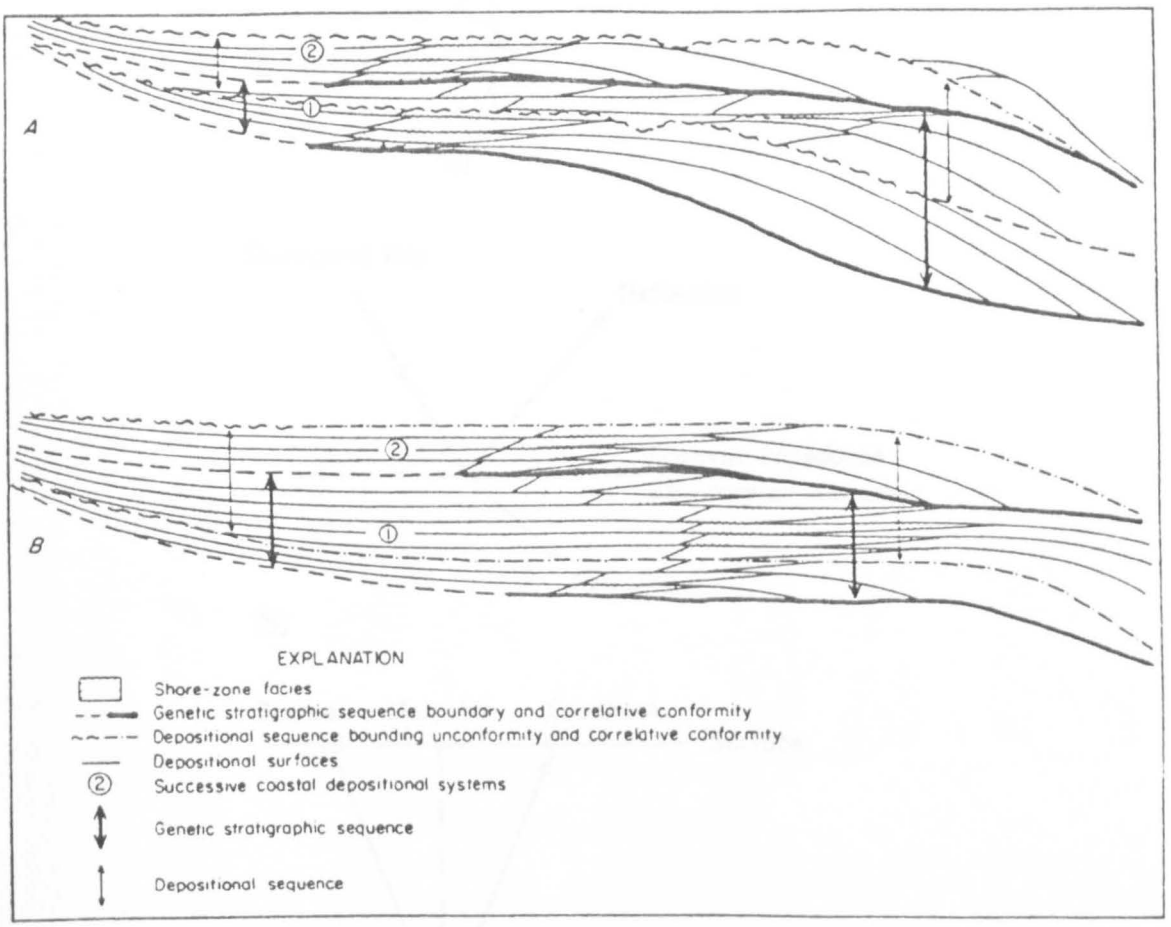
HST = HIGHSTAND SYSTEMS TRACT

TST = TRANSGRESSIVE-SYSTEMS TRACT
- ivf = incised-valley fill

LST = LOWSTAND SYSTEMS TRACT
- ivf = incised-valley fill
- lsw = lowstand wedge
- pgc = prograding complex
- mf / co = mass flow / channel overbank deposits
- lsf = lowstand fan
  - fc = fan channels
  - fl = fan lobes

SMW = SHELF MARGIN WEDGE SYSTEMS TRACT

Figure 39. The main elements of the sequence stratigraphic depositional model as proposed by Vail and co-workers. (from Baum and Vail 1988)



'igure 40. Comparison of the depositional sequence defined by Vail and co-workers, the 'Exxon' model, with the genetic sequence defined by Galloway. The Galloway model uses maximum flooding surfaces to define the sequence boundary, whereas the Vail model emphasises unconformities as sequence boundaries. Where base level does not drop below the platform margin (B) the unconformities are obscure and flooding surface are more easily recognised. (From Galloway 1989)

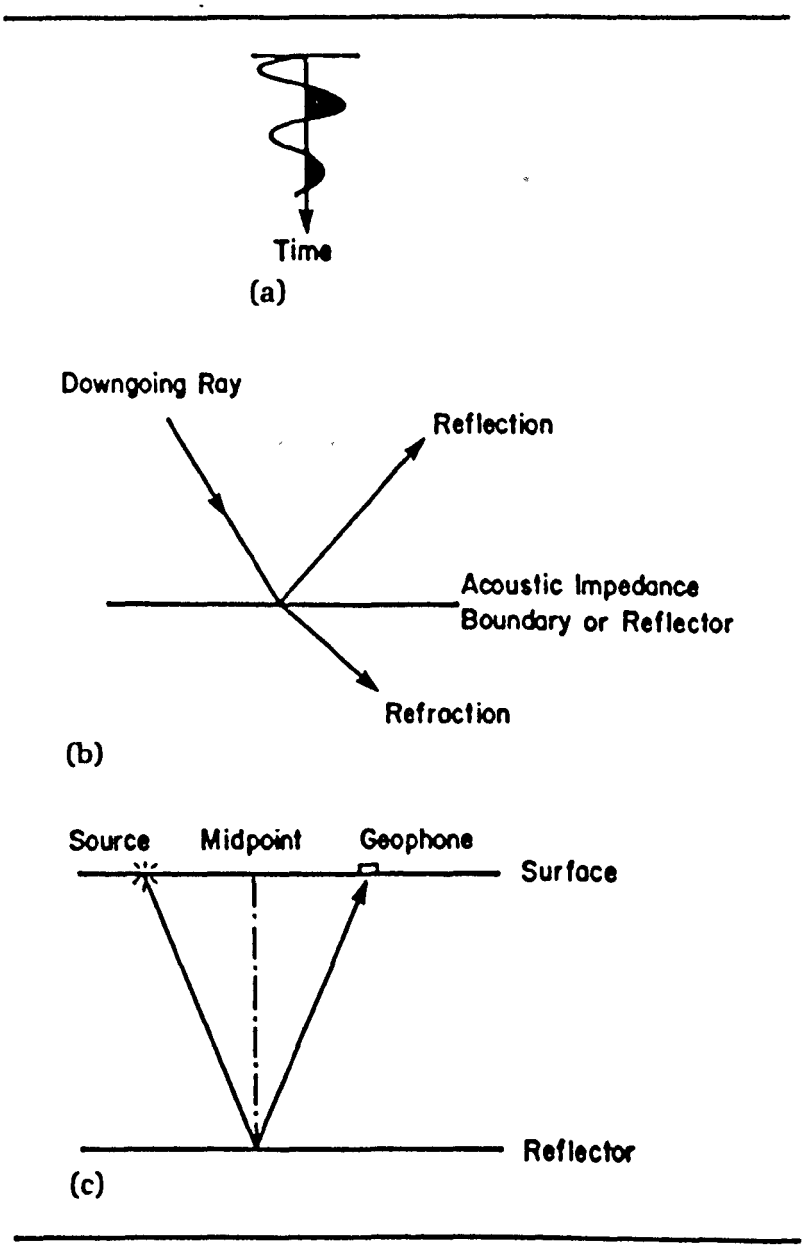
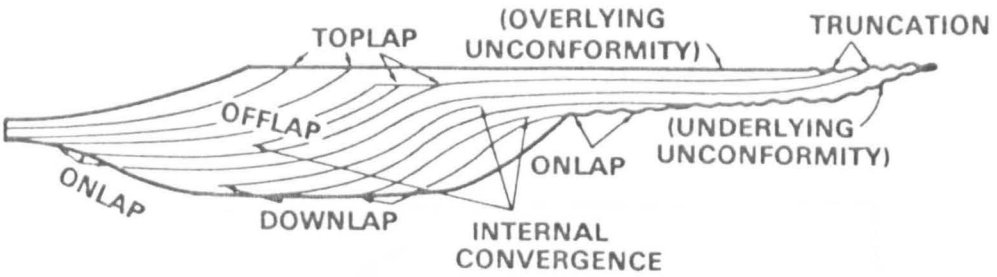


Figure 41. The main elements of seismic acquisition. (a) Diagrammatic representation of the source wavelet. (b) Reflection and refraction at an acoustic-impedance boundary (eg. lithological boundary, diagenetic change, fluid change or fault surface). (c) Reflection geometry for a horizontal reflector. (from Badley 1985)



A. Refection relationships within an idealised seismic sequence.

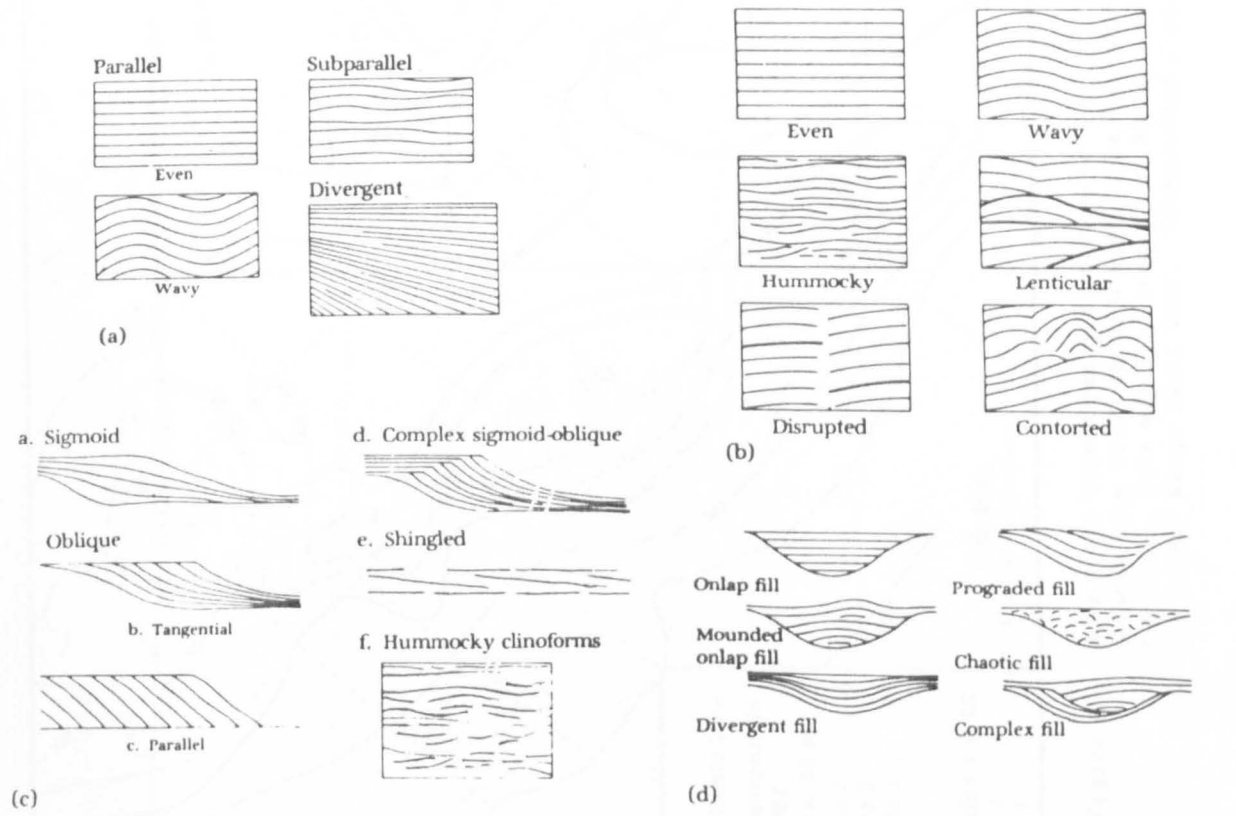


Figure 42. B. Examples of diagnostic reflection configurations.

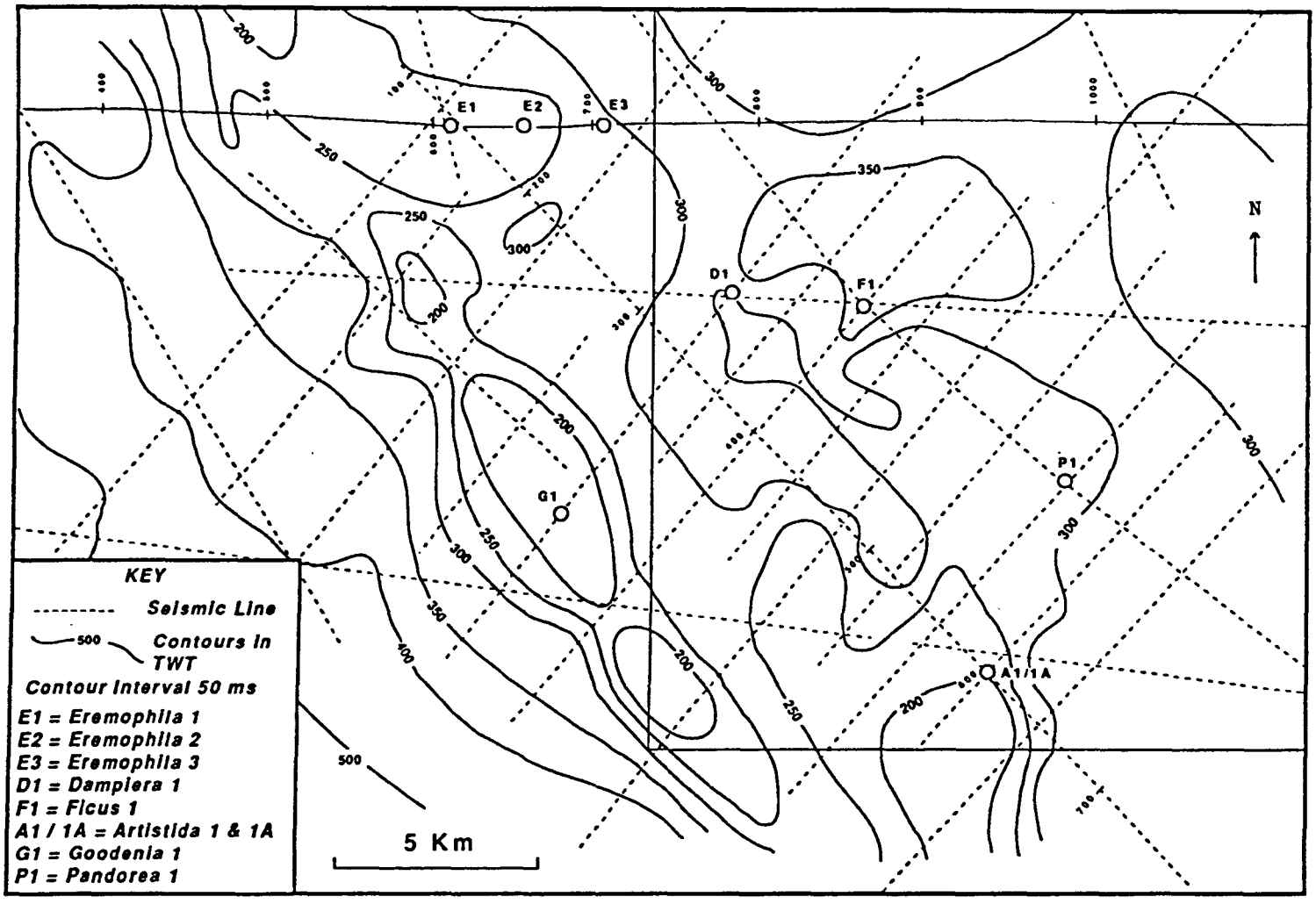


Figure 43. Base Grant Unconformity Structure in Time Map for the Eremophila area. Seismic line 82-20 through Eremophila 1, 2 and 3 is displayed on Figure 33. This map illustrates the NW-SE trending high located along the Dummer Range Fault Zone. (Summarised from WMC regional mapping)

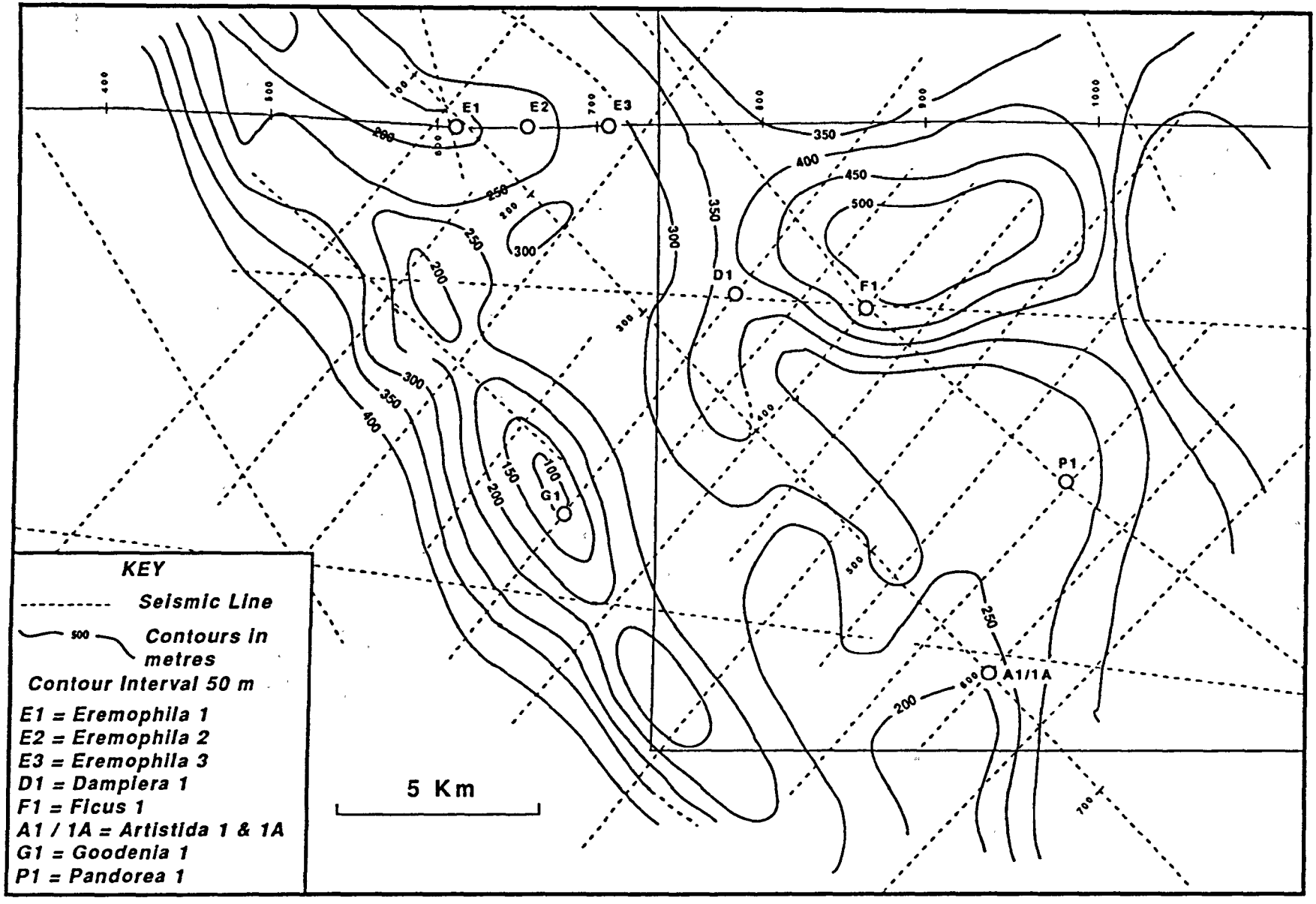


Figure 44. Depth to Base Grant Unconformity. (Interpreted from the structure in time map and well control). The Grant Group thins onto the highs and thickens into the lows, suggesting a structural control on deposition.

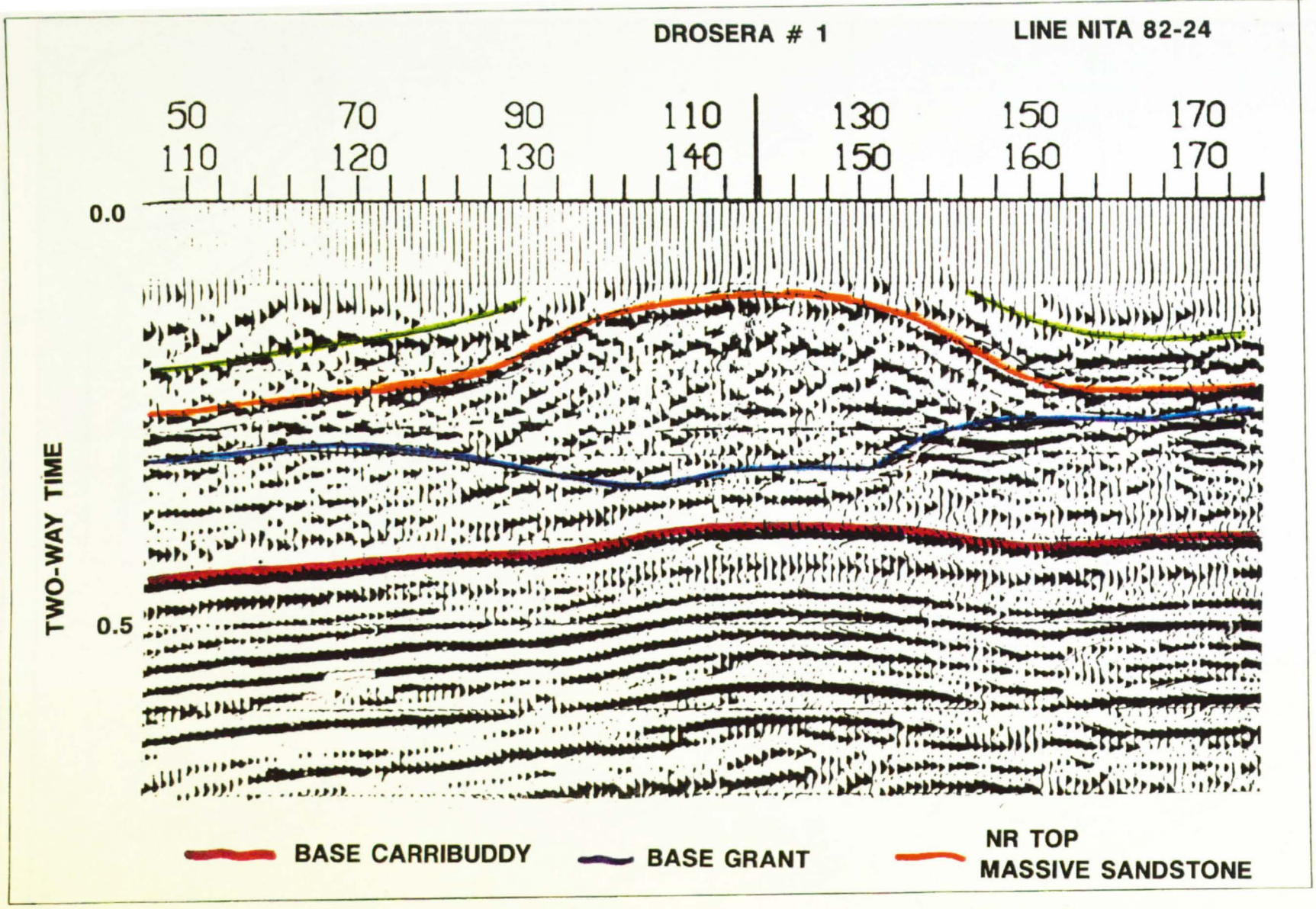


Figure 45. Detail of seismic line 82-24 (see Enclosure 2). The large mounded feature was cored by Drosera 1, which encountered a thick sequence of Grant Group sandstones resting on a sharp unconformity with the Carribuddy Formation.

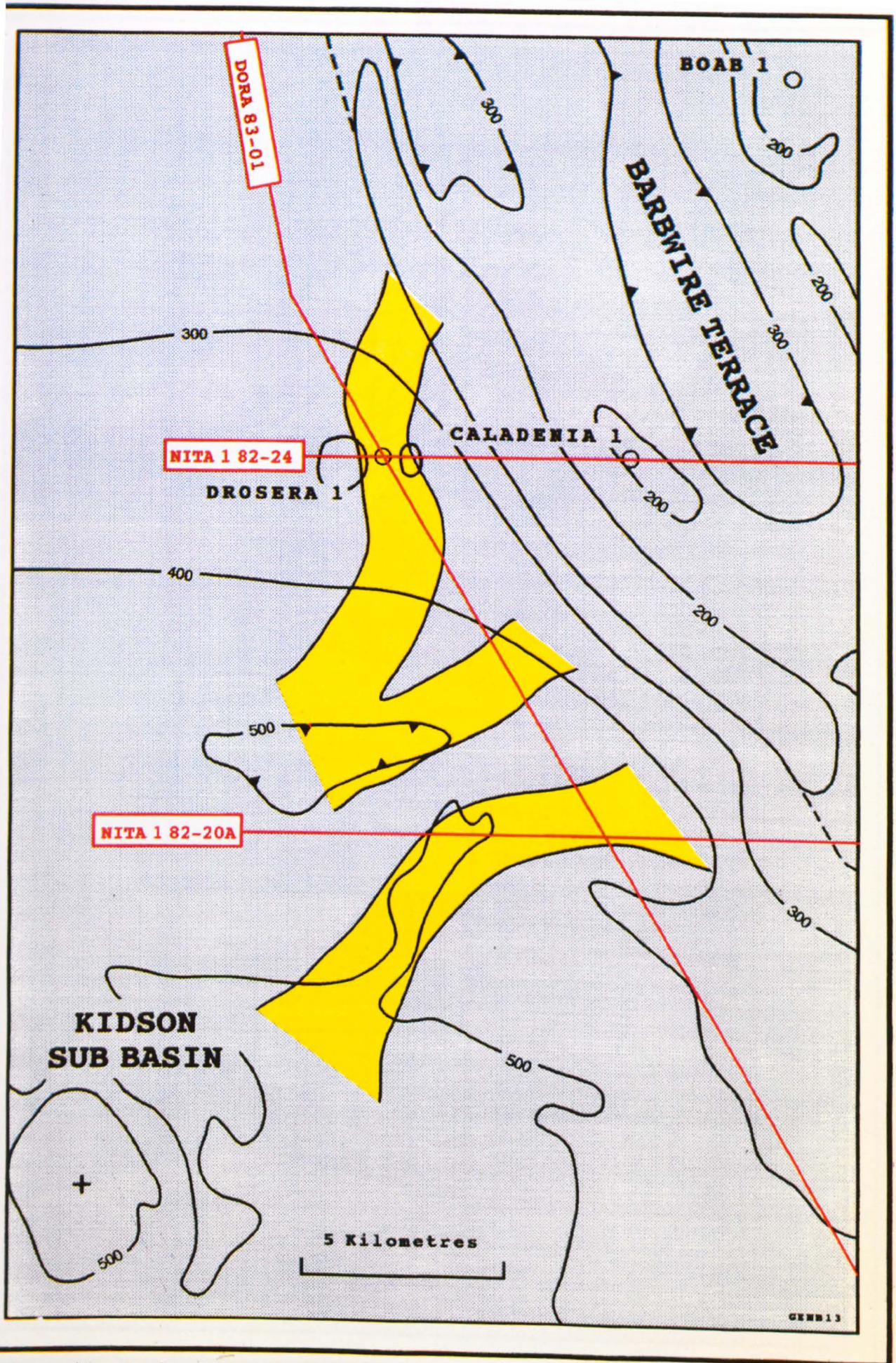


Figure 46. Regional interpretation of the 'mounded seismic facies', with apparent linear features trending away from the Barbwire Terrace. Displayed on Base Grant Unconformity structure in time map. (Line 82-24 is shown on Figure 45 and Enclosure 1, line 82-20a on Figure 48)

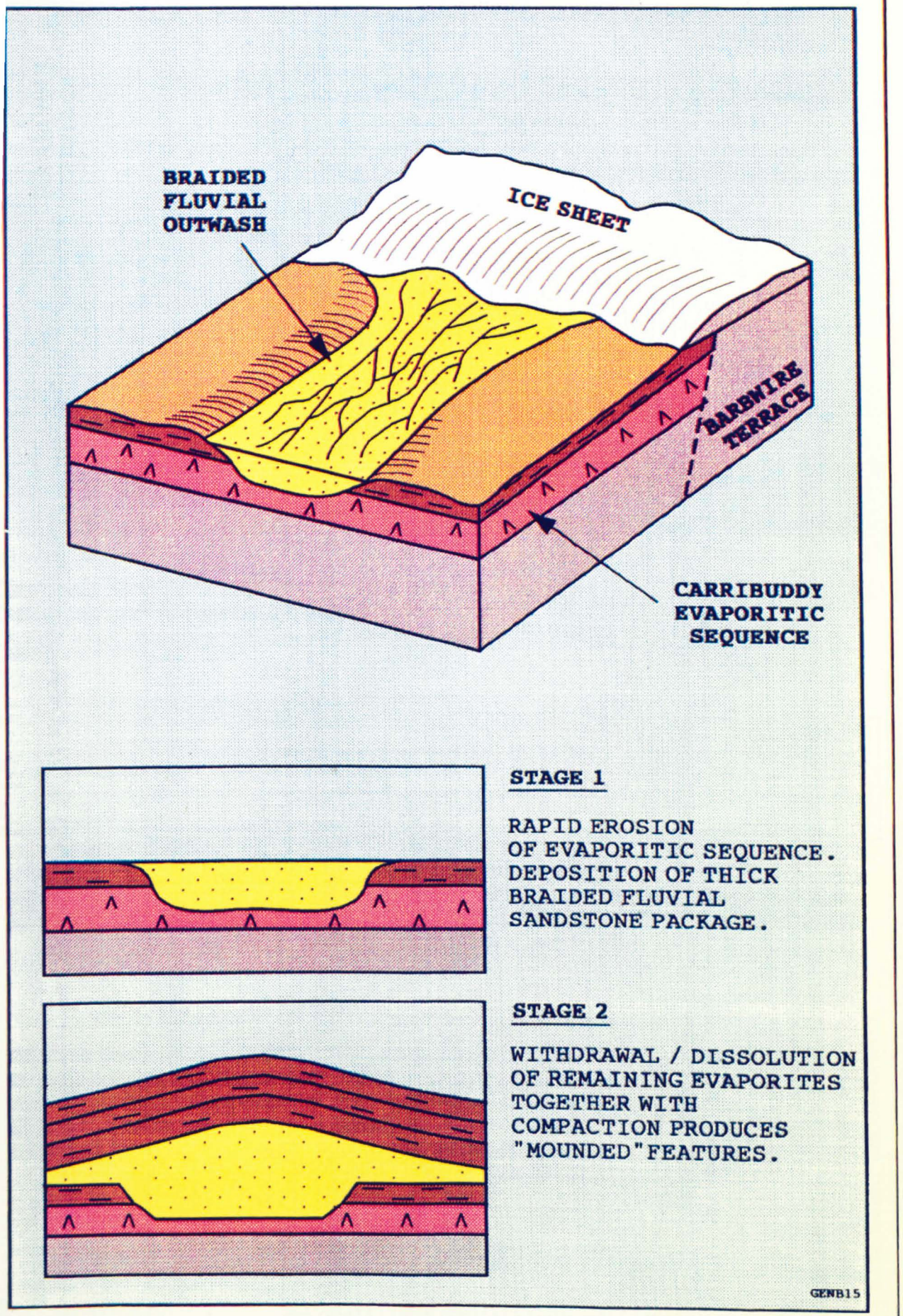


Figure 47. Proposed depositional environment for the sandstones encountered in Drosera 1 and Kunzea 1, within a schematic palaeogeographic setting, and a model for the formation of the mounded features.

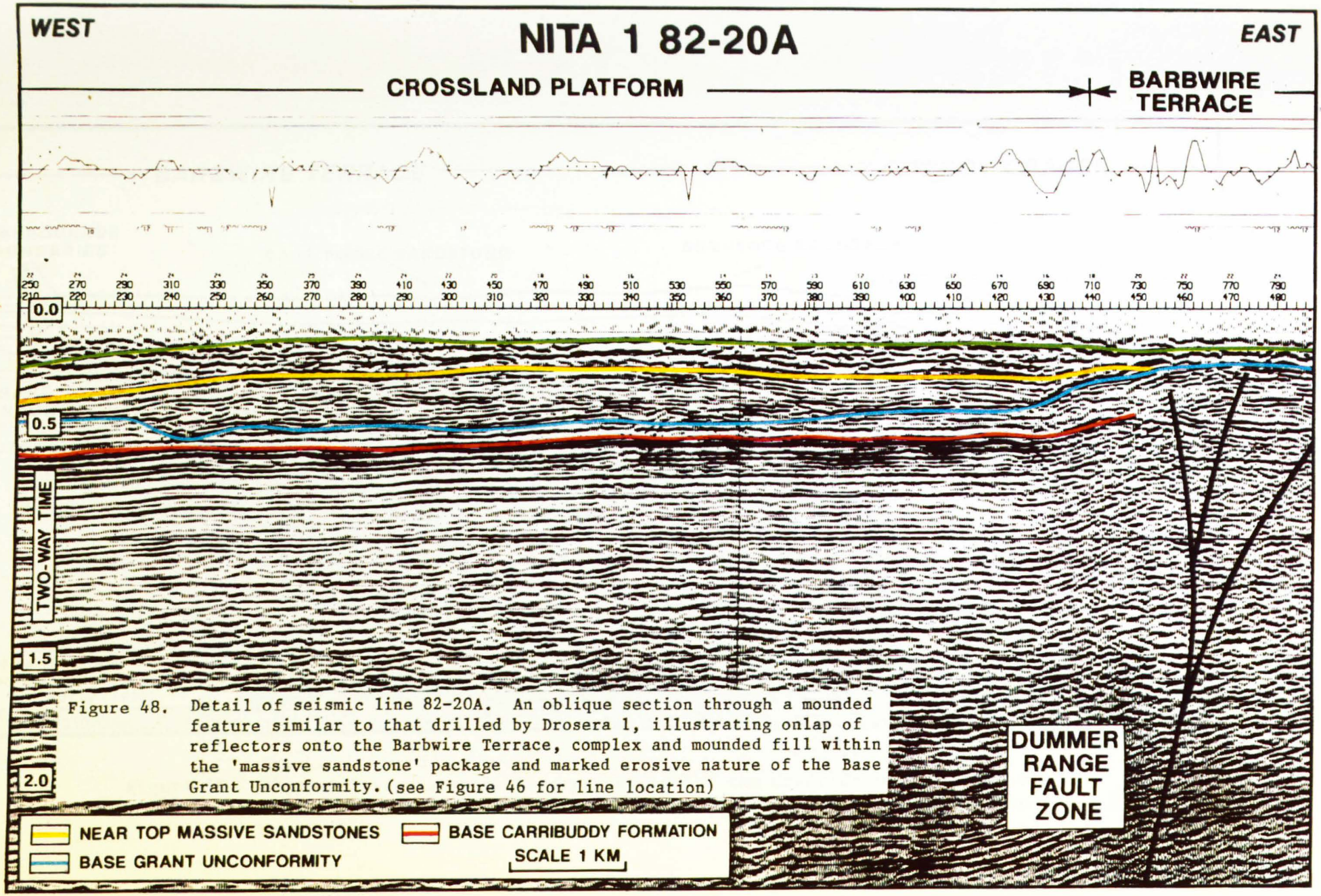


Figure 48. Detail of seismic line 82-20A. An oblique section through a mounded feature similar to that drilled by Drosera 1, illustrating onlap of reflectors onto the Barbwire Terrace, complex and mounded fill within the 'massive sandstone' package and marked erosive nature of the Base Grant Unconformity. (see Figure 46 for line location)

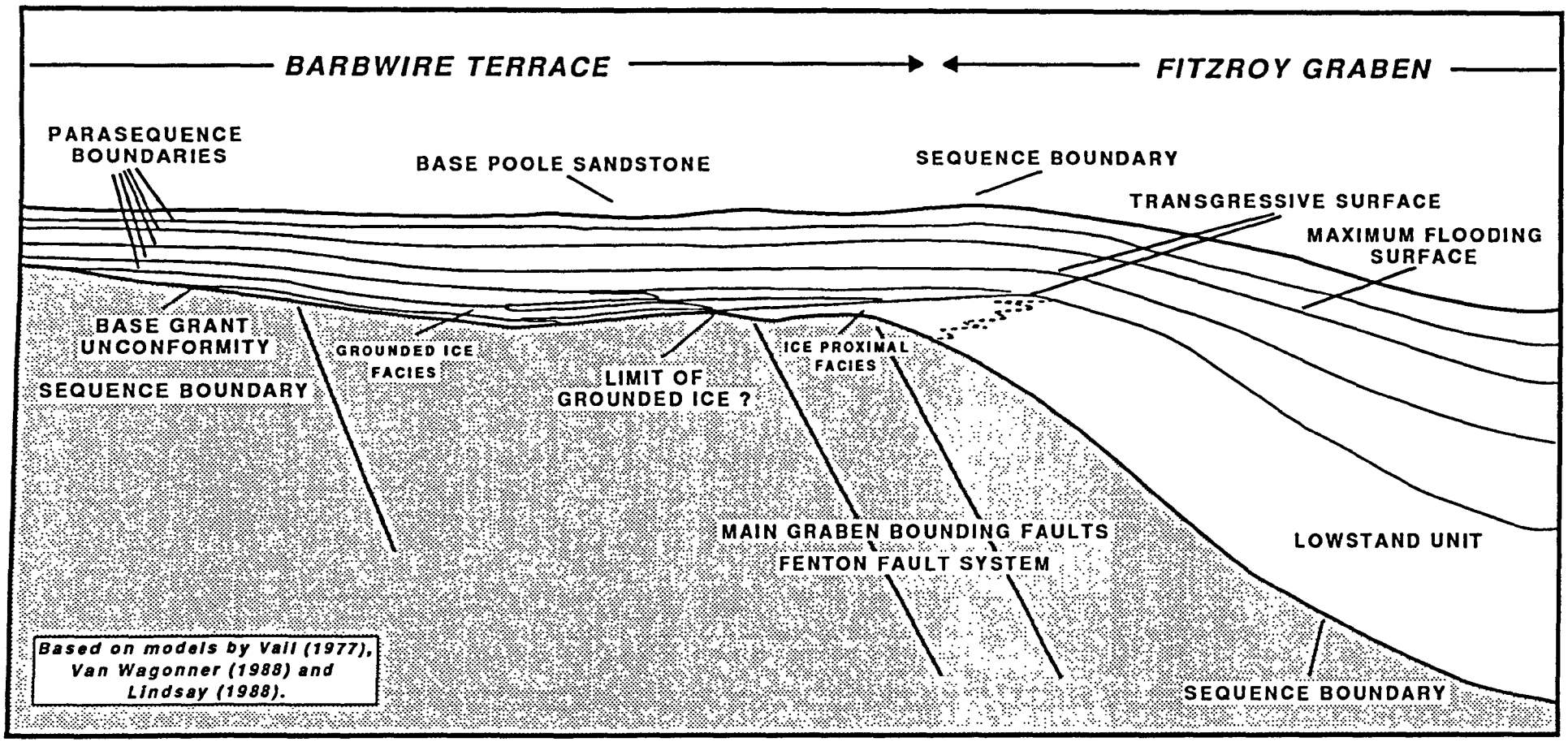


Figure 49. Sequence stratigraphic interpretation for the Grant Group deposited on the Barbwire Terrace and Fitzroy Graben, displaying the main sequence boundaries.

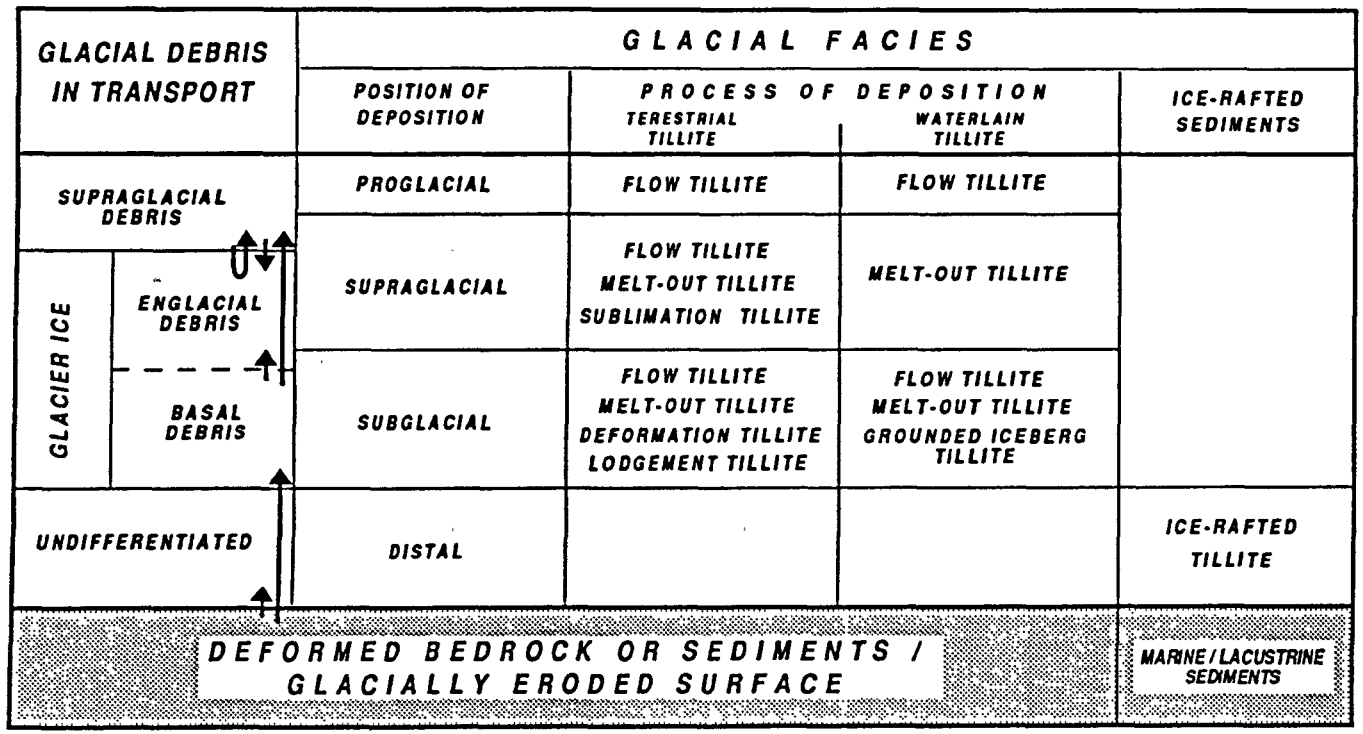


Figure 50. Classification of glacial deposits, illustrating the relationship between the transport of glacial debris and the process of deposition. (after Hambrey and Harland 1981)

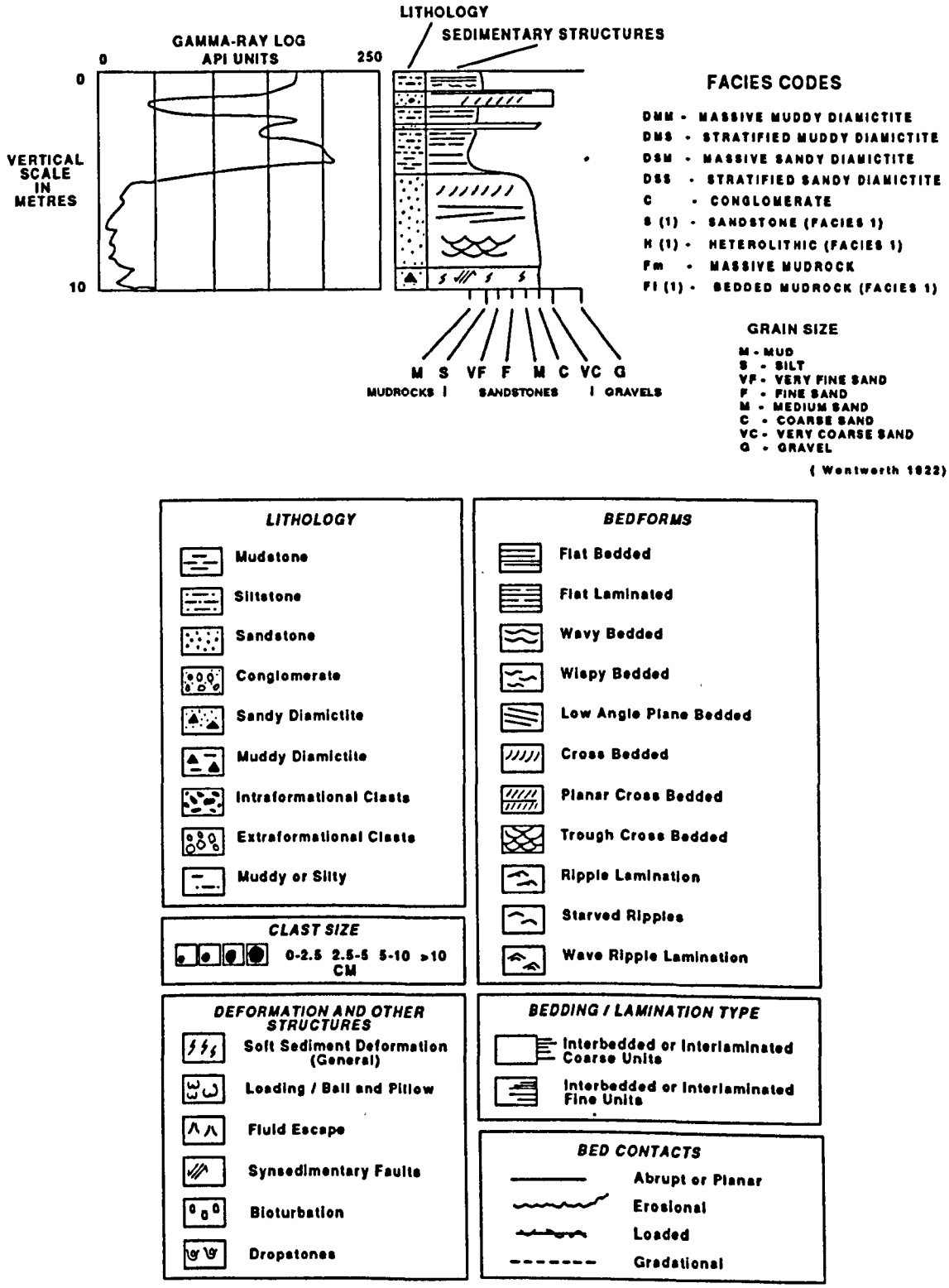


Figure 51. Key to facies log annotation (this is duplicated in Appendix 1

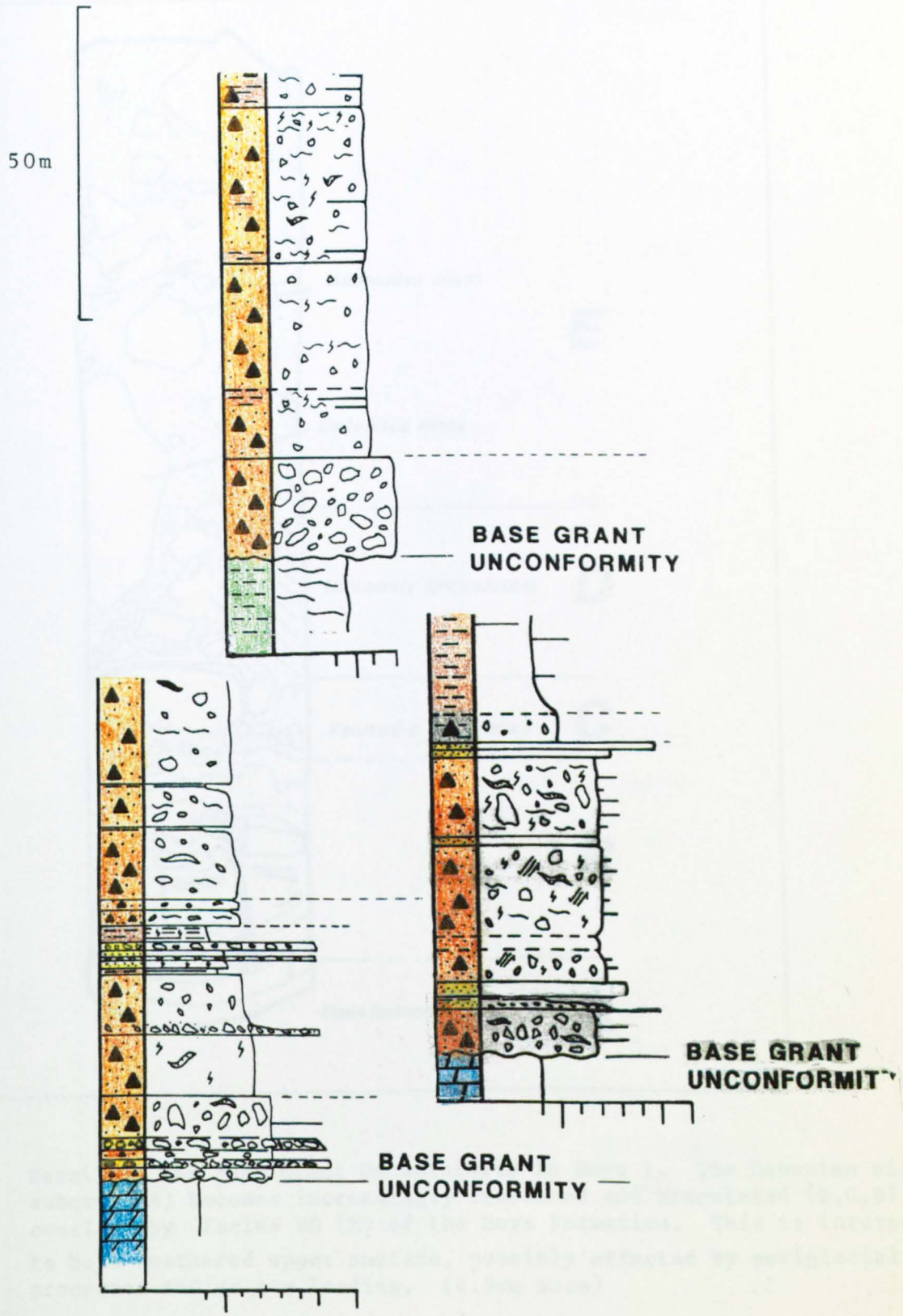


Figure 52. Typical facies logs for the Basal Diamictite Facies Association (BD). A. Hoya 1 B. Eremophila 2 C. Aristida 1

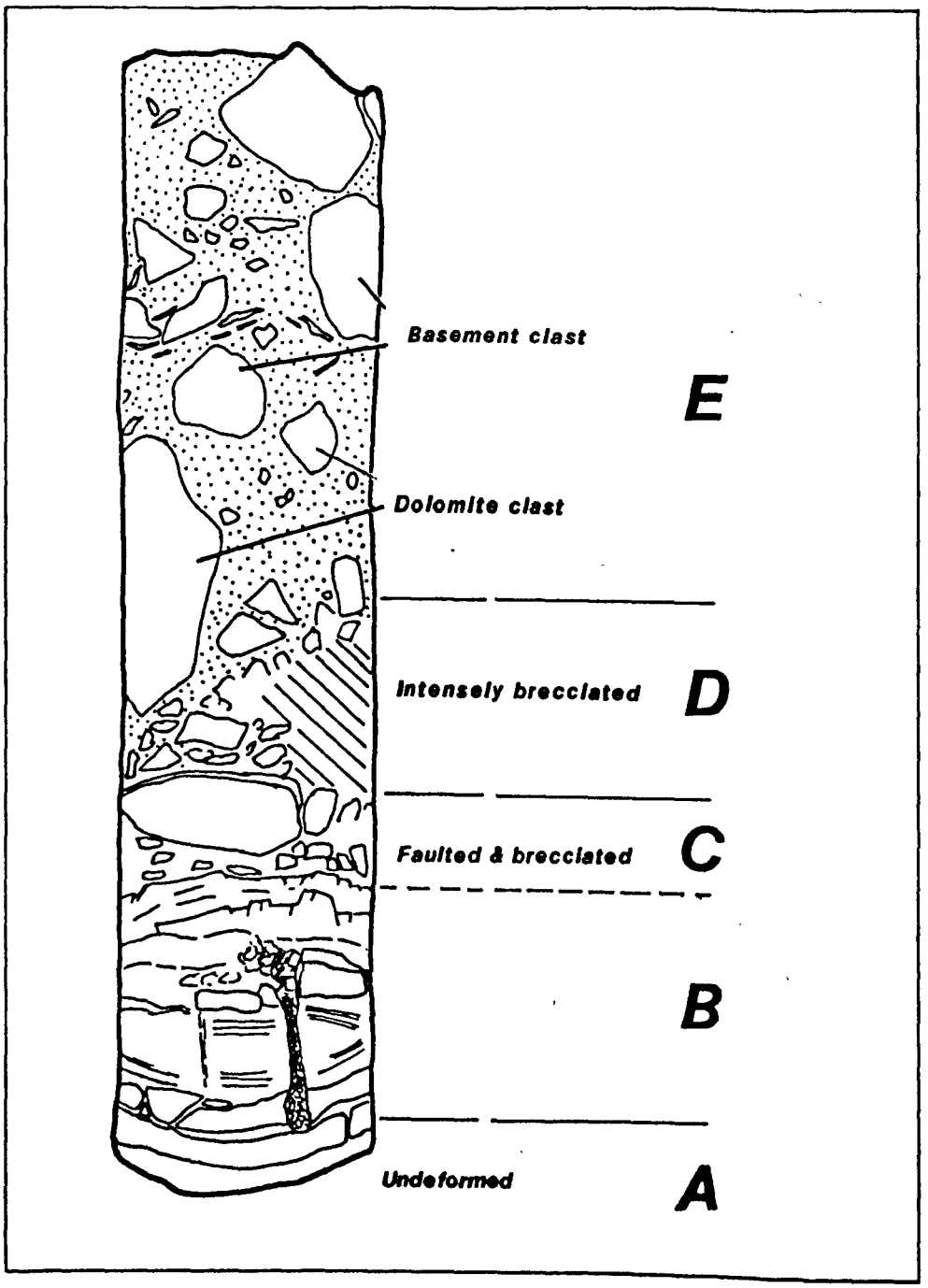


Figure 53. Detail of the Base Grant Unconformity in Hoya 1. The Devonian siltstone subcrop (A) becomes increasingly fractured and brecciated (B,C,D) and is overlain by Facies BD (E) of the Hoya Formation. This is interpreted to be a weathered upper surface, possibly affected by periglacial processes and/or ice loading. (4.5cm core)

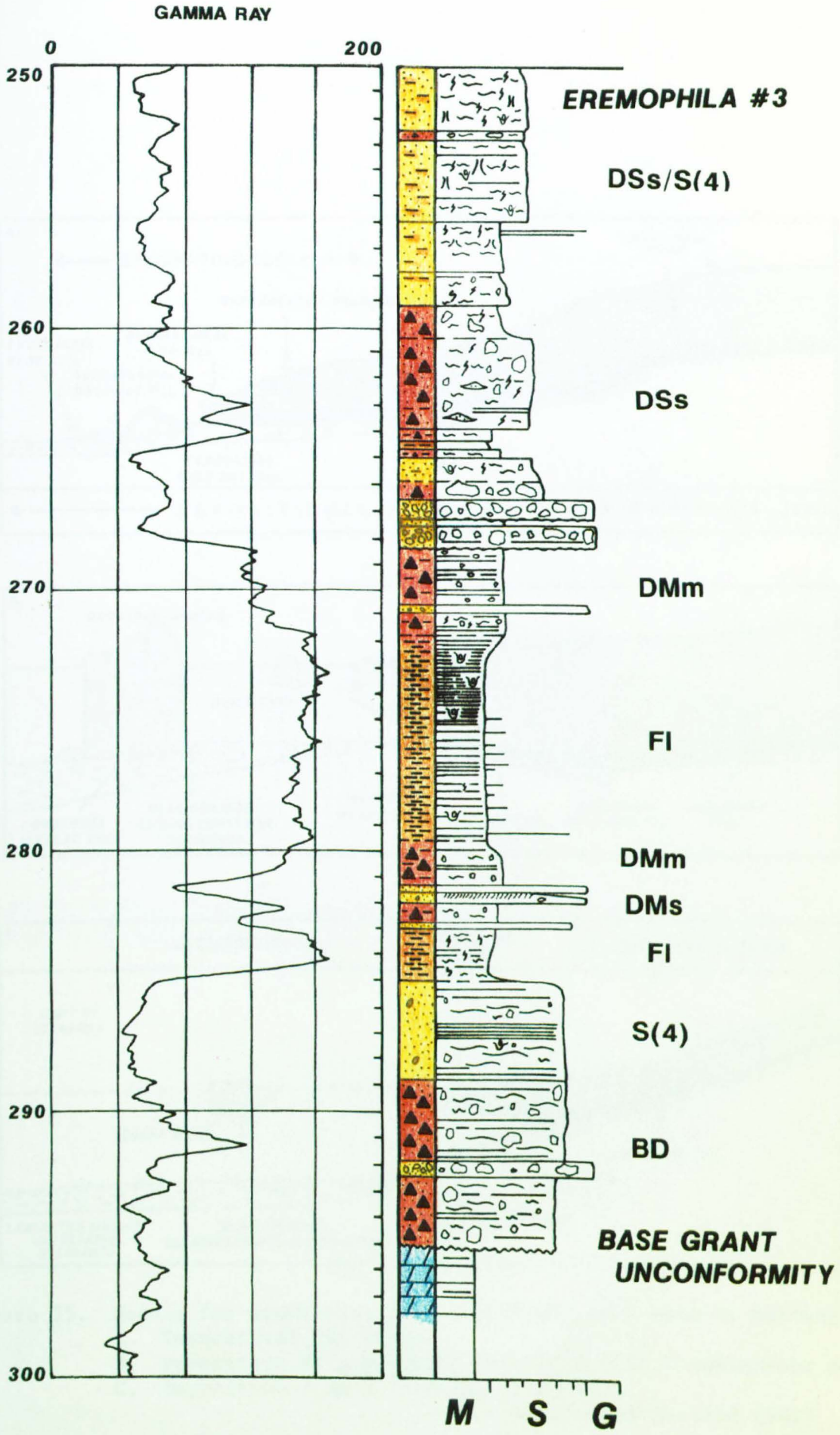


Figure 54. A section of the Hoya Formation from Eremophila 3, which displays the relationship between the facies.

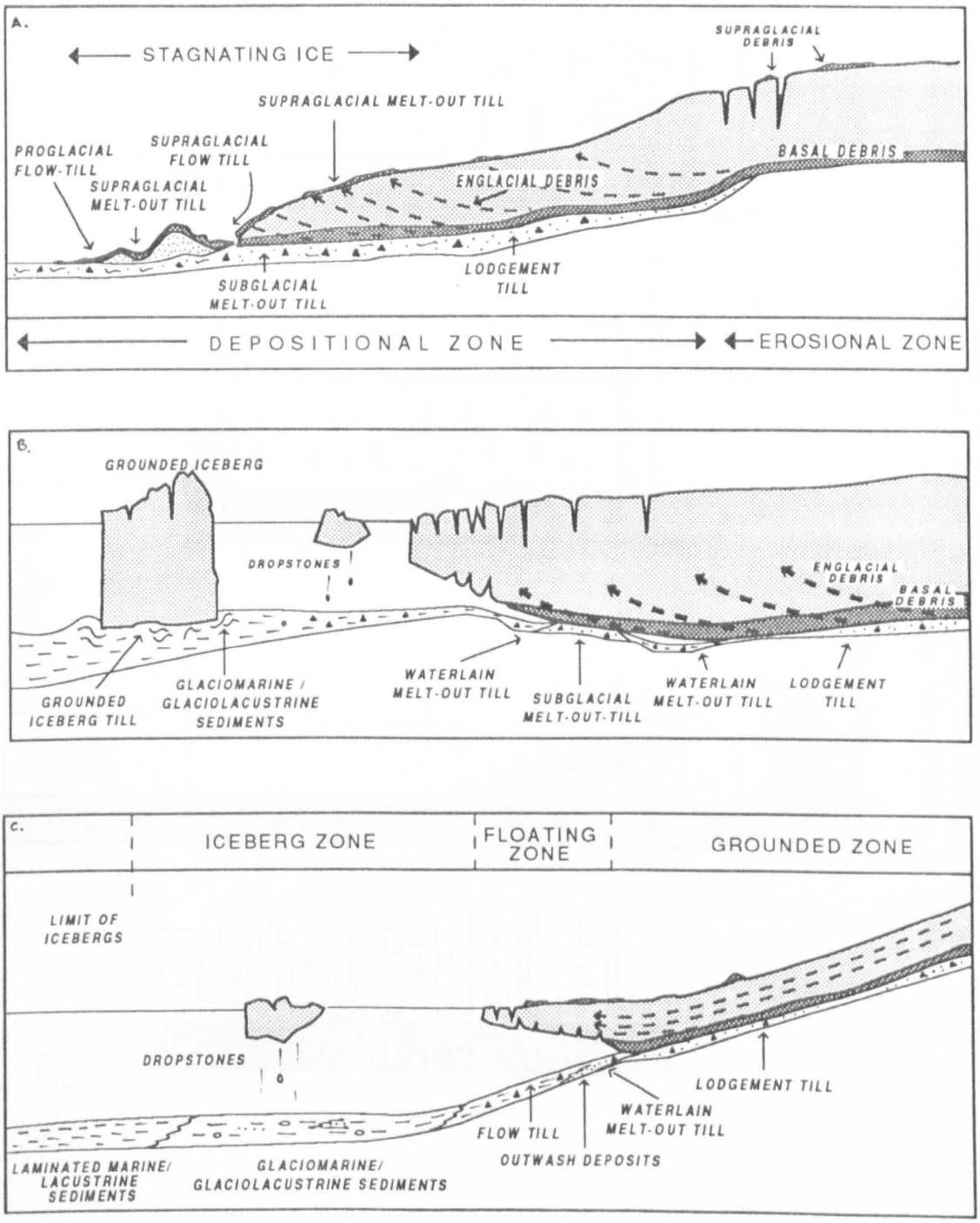


Figure 55. Models for deposition from ice sheets with base at melting point
A. Terrestrial deposition.
B. Deposition from grounded ice sheet into a subaqueous setting
C. Deposition from a floating ice sheet.
(from Hambrey and Harland 1981)

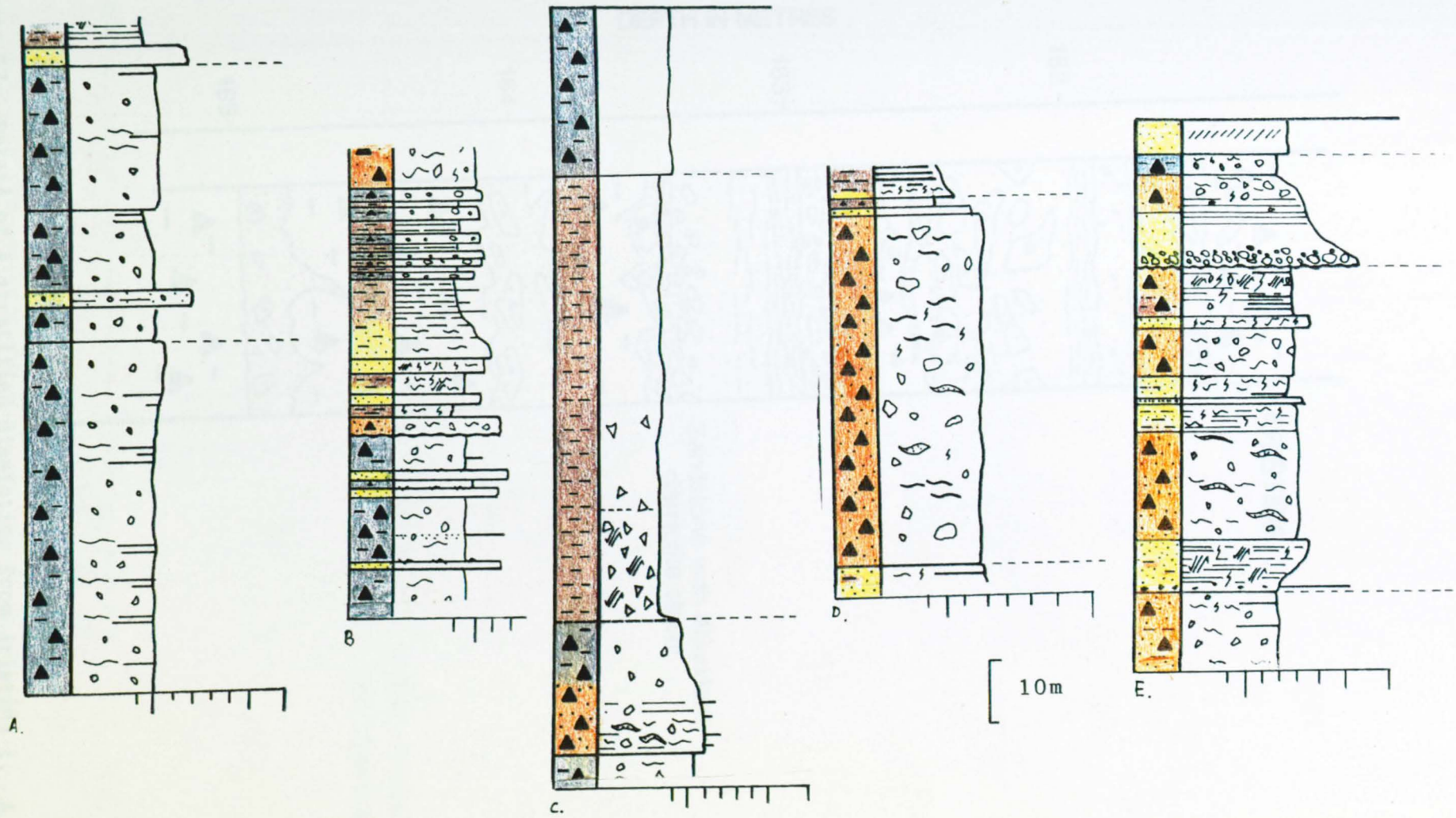


Figure 56. Typical facies logs for:
A. Massive muddy diamictite facies (DMm). (Hoya 1)
B. Stratified muddy diamictite facies (DMs).(Calytrix 1)
C. An upper gradational contact and lower sharp contact between facies DMm and facies Fm. (Hoya 1)
D. Massive sandy diamictite facies (DSm). (Eremophila 3)
E. Stratified sandy diamictite facies (DSs). (Hoya 1)

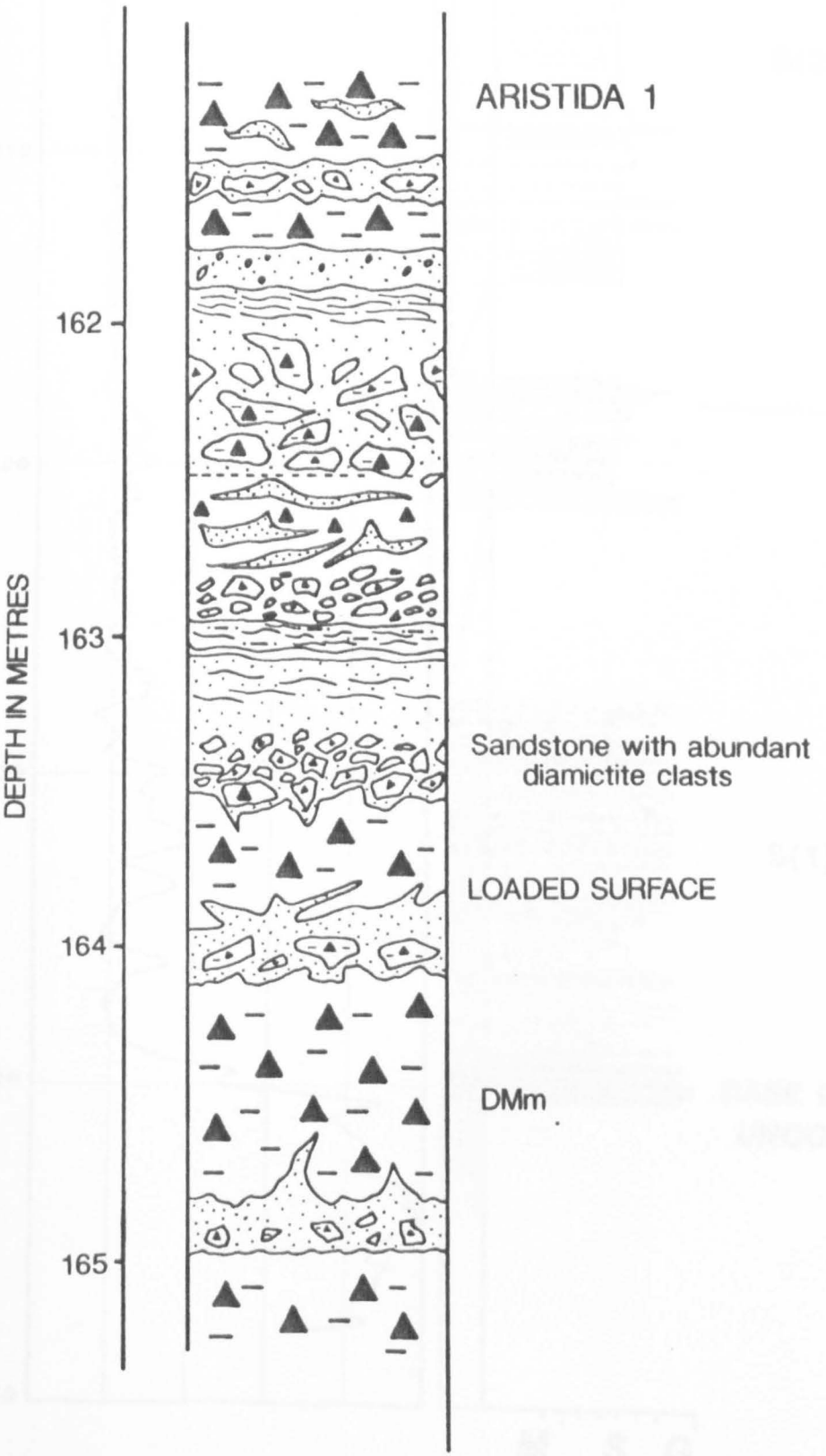


Figure 57. Detail of a stratified diamictite from Aristida 1. A medium-grey muddy diamictite (DMm) is interbedded with fine-grained sandstones, containing abundant diamictite rip-up clasts. The muddy diamictite is interpreted to be a basinal rain-out deposit. The interbedded sandstones indicate intermittent high-energy mass flows.

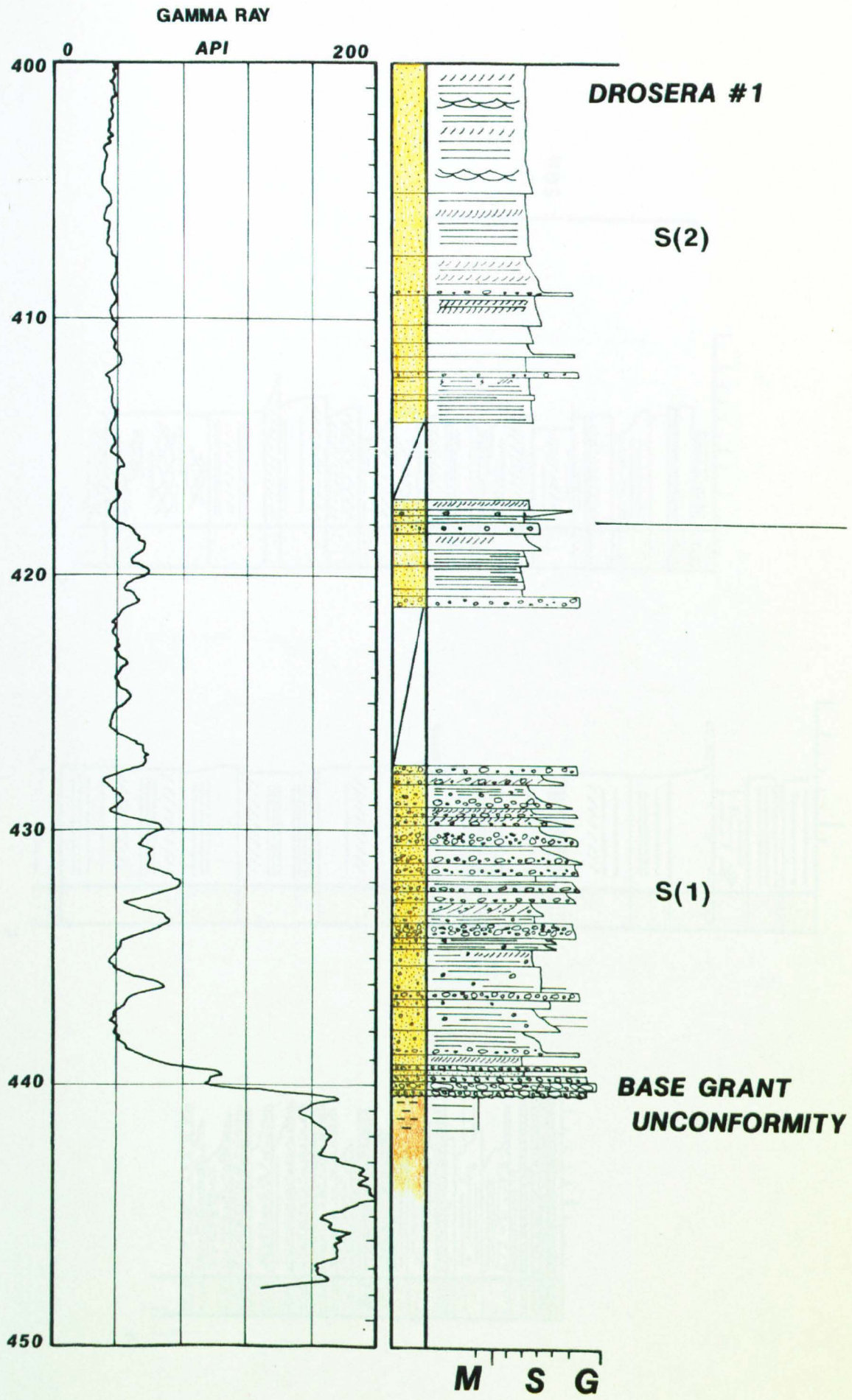


Figure 58. The relationship and gamma-ray log character of Sandstone Facies 1 and Sandstone Facies 2 from Drosera 1.

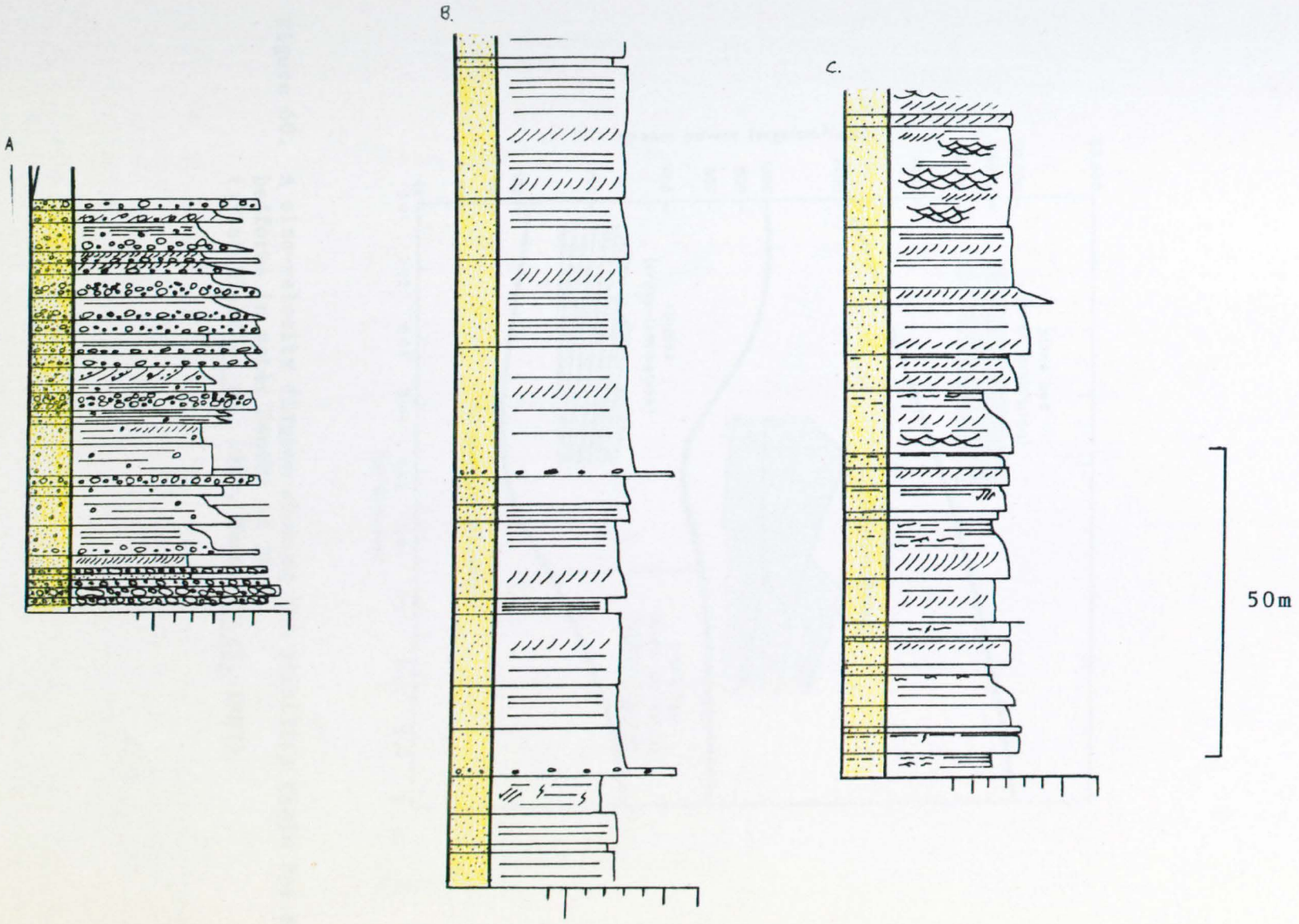


Figure 59. Typical facies logs for:
A. Sandstone Facies 1 (Drosera 1)
B. Sandstone Facies 2 (Drosera 1)
C. Sandstone Facies 3 (Drosera 1)

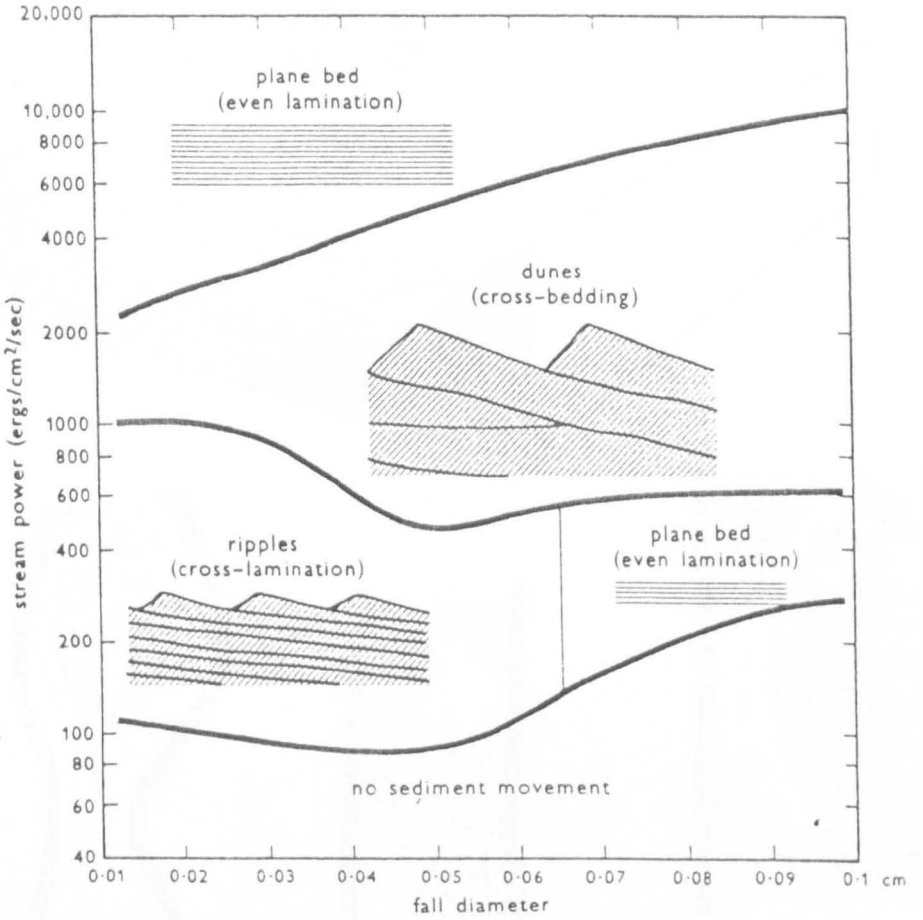


Figure 60. A size-velocity diagram showing the stability field for different bedforms in water depths of 20cm.
(after Blatt et al. 1980, Harms et al. 1982).

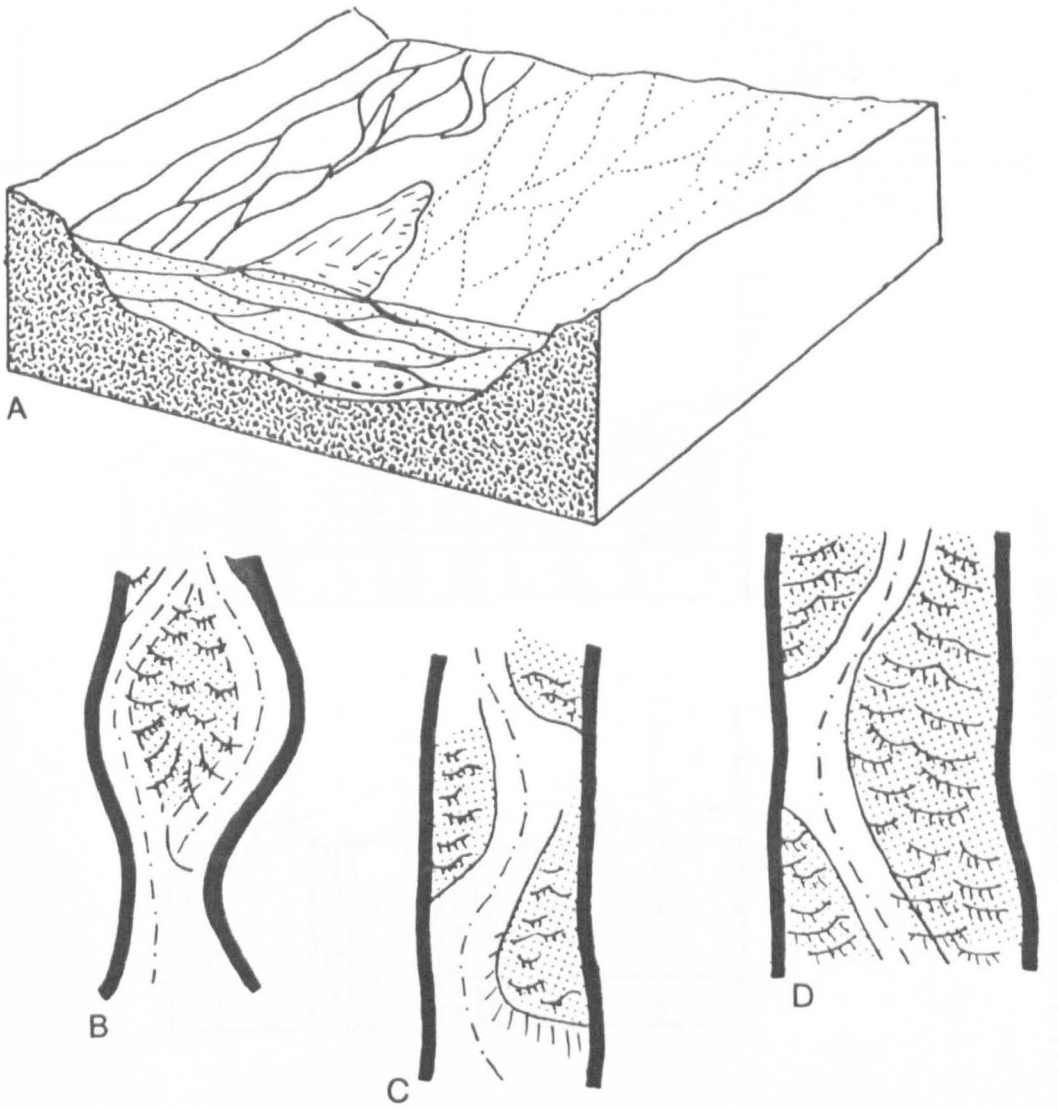


Figure 61. A. Block diagram illustrating the deposition of sheet sandstones within a braided river system, restricted laterally by topographic features. In detail the sandstones will contain abundant stratification types relating to the migration of bars and in-channel dunes.

Definition diagram for different bar types on a sandy river bed. B. Mid-channel or longitudinal bar C. Alternate or transverse bars with large scale slip faces D. Side bars.

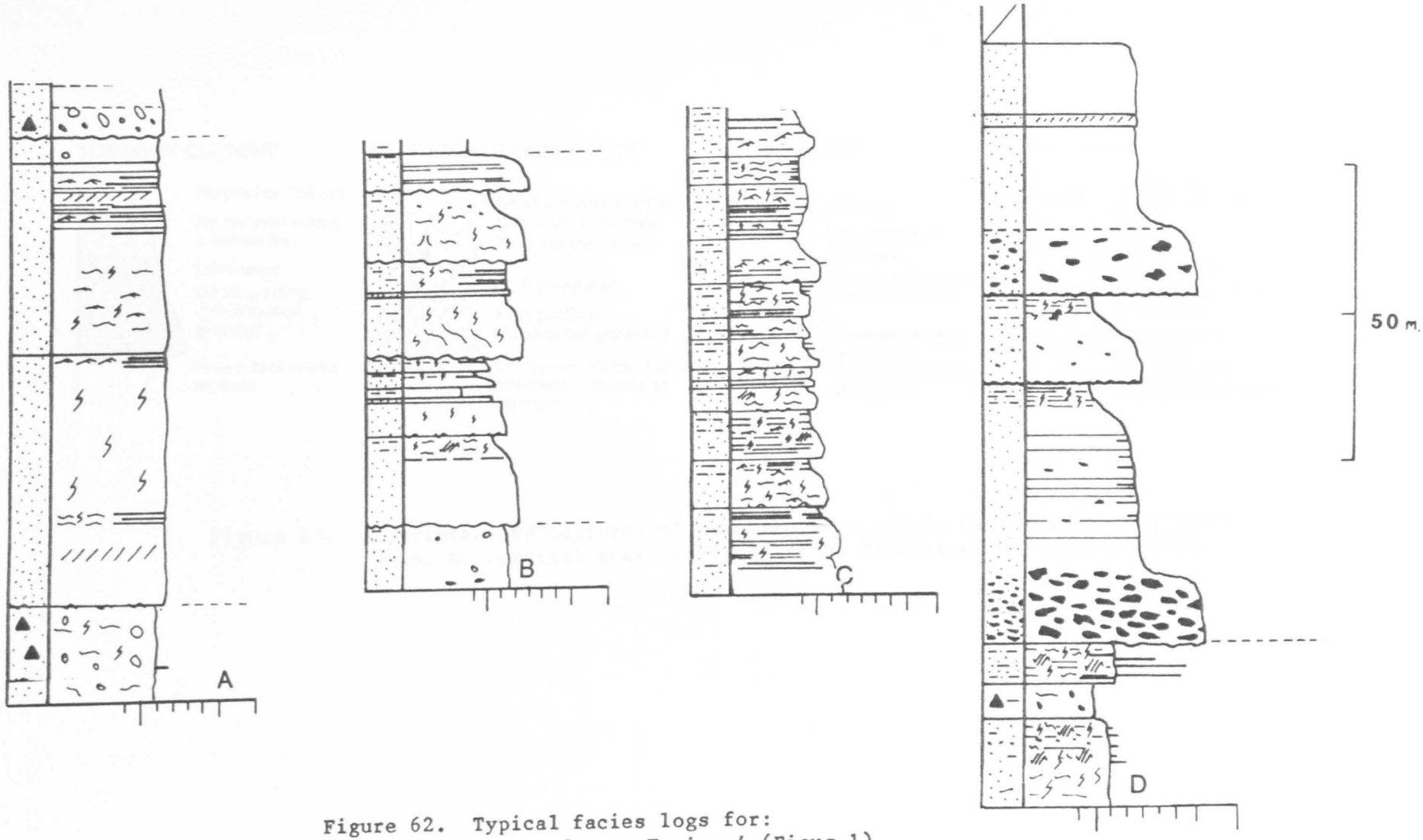


Figure 62. Typical facies logs for:
A. Sandstone Facies 4 (Ficus 1)
B. Sandstone Facies 5 (Ficus 1)
C. Sandstone Facies 6 (Melaleuca 1)
D. Sandstone Facies 7 (Hoya 1)

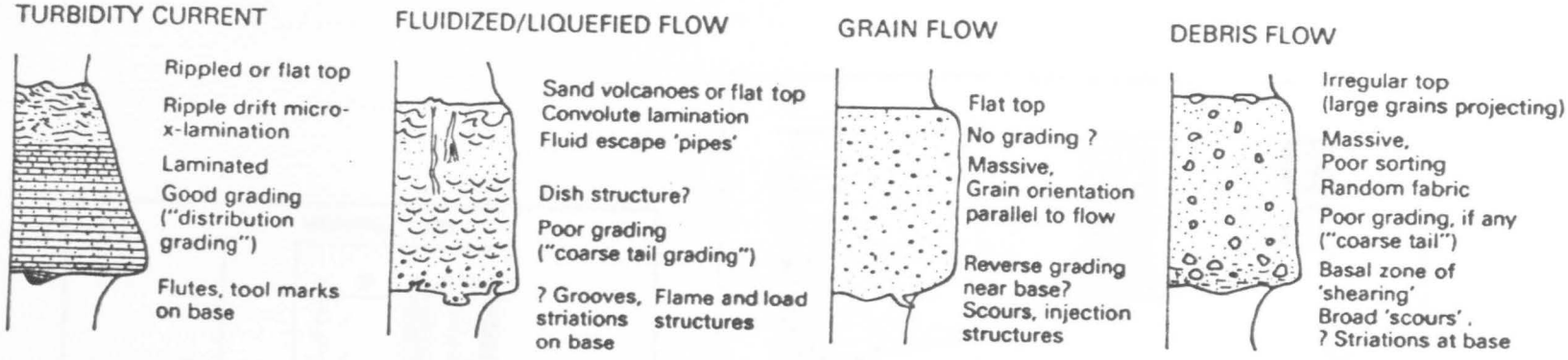
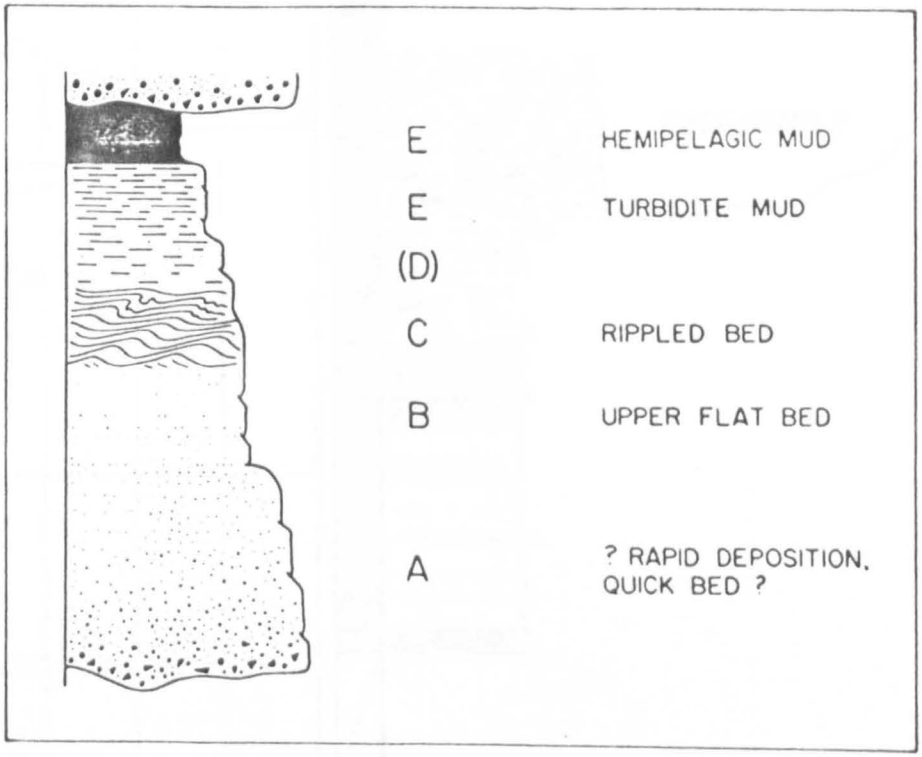


Figure 63. Structures and textures of deposits from single mechanism mass-gravity flows. No vertical scale implied. (from Middleton and Hampton 1976)



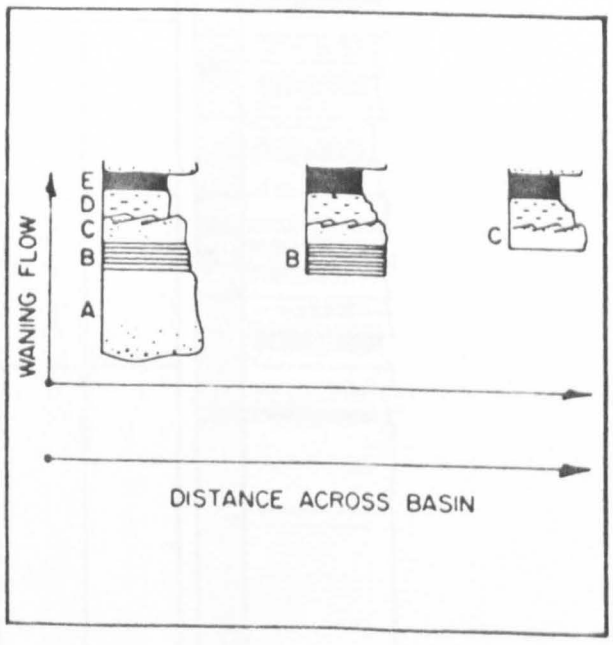


Figure 64. A. The divisions of the idealised 'Bouma' sequence.

B. Idealised change in turbidite character due to waning flow for proximal and distal locations.

FROM WALKER 1984

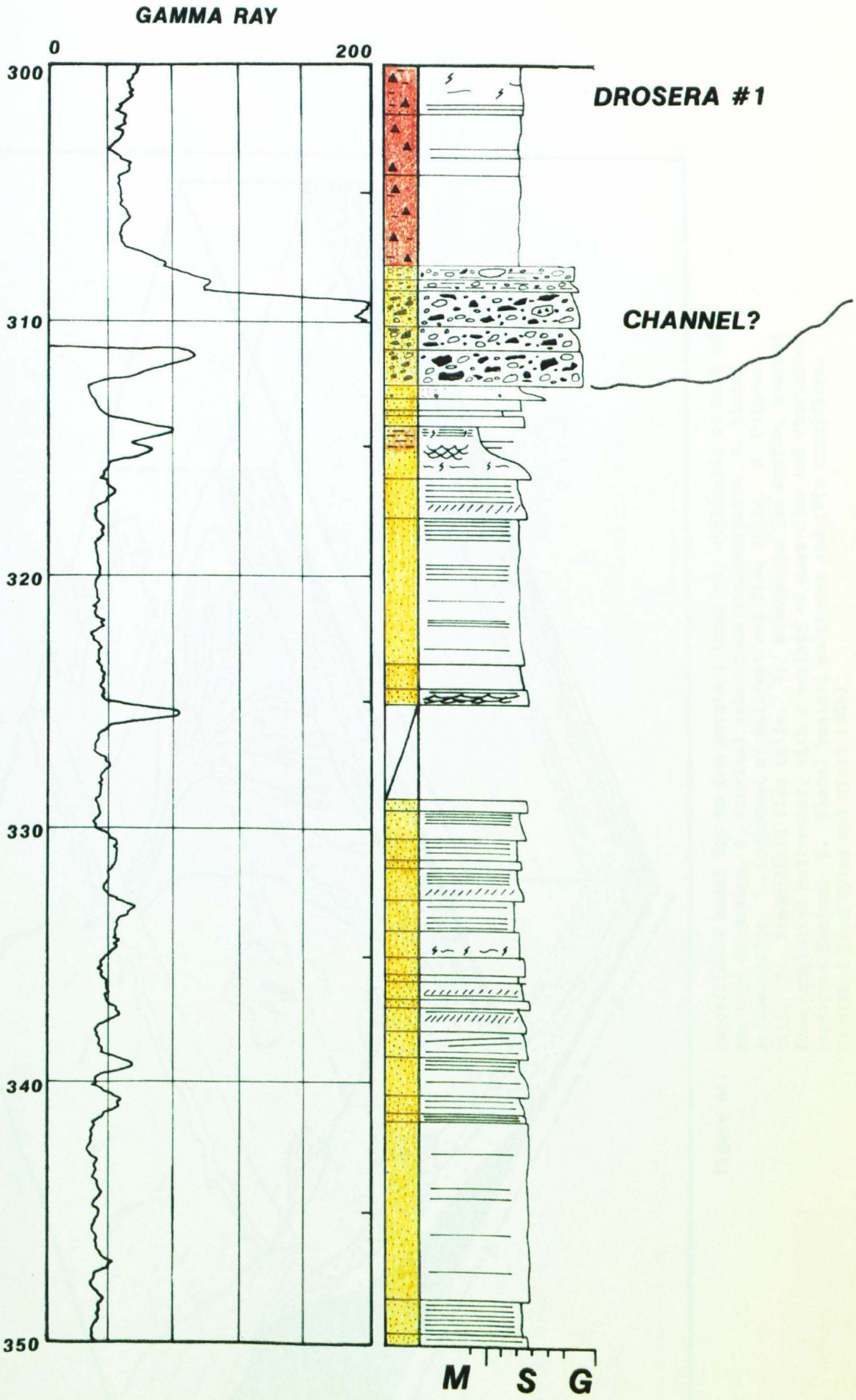


Figure 65. Detail of Drosera 1, displaying the upper section of Sandstone Facies cut by a stacked series of intraclast conglomerates (Sandstone Facies 7) interpreted to be a possible subaqueous channel.
(from Walker 1984)

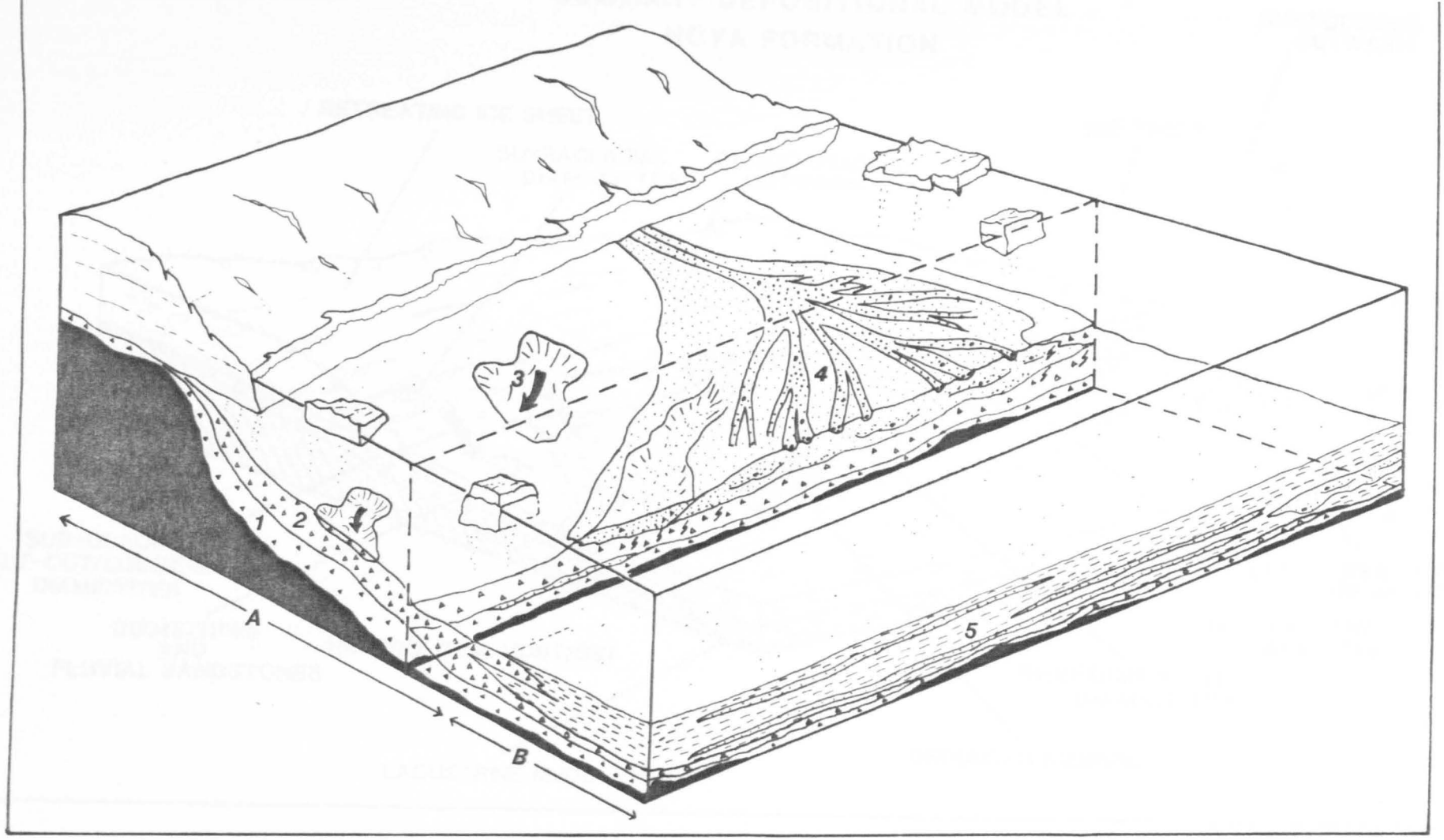


Figure 66. Depositional model for an ice marginal location, applicable to much of the Hoya Formation. A. Proximal subaqueous sedimentation B. Distal sedimentation 1. Lodgement or melt-out and flow tills. 2. Rain-out till. 3. Remobilised flow tills. 4. Subaqueous fan system, sourced from subglacial melt-water, with a variety of mass-flow and channelled sandstone facies. 5. Distal basinal mudstones and thin turbidites. (Modified from Eyles and Miall 1984)

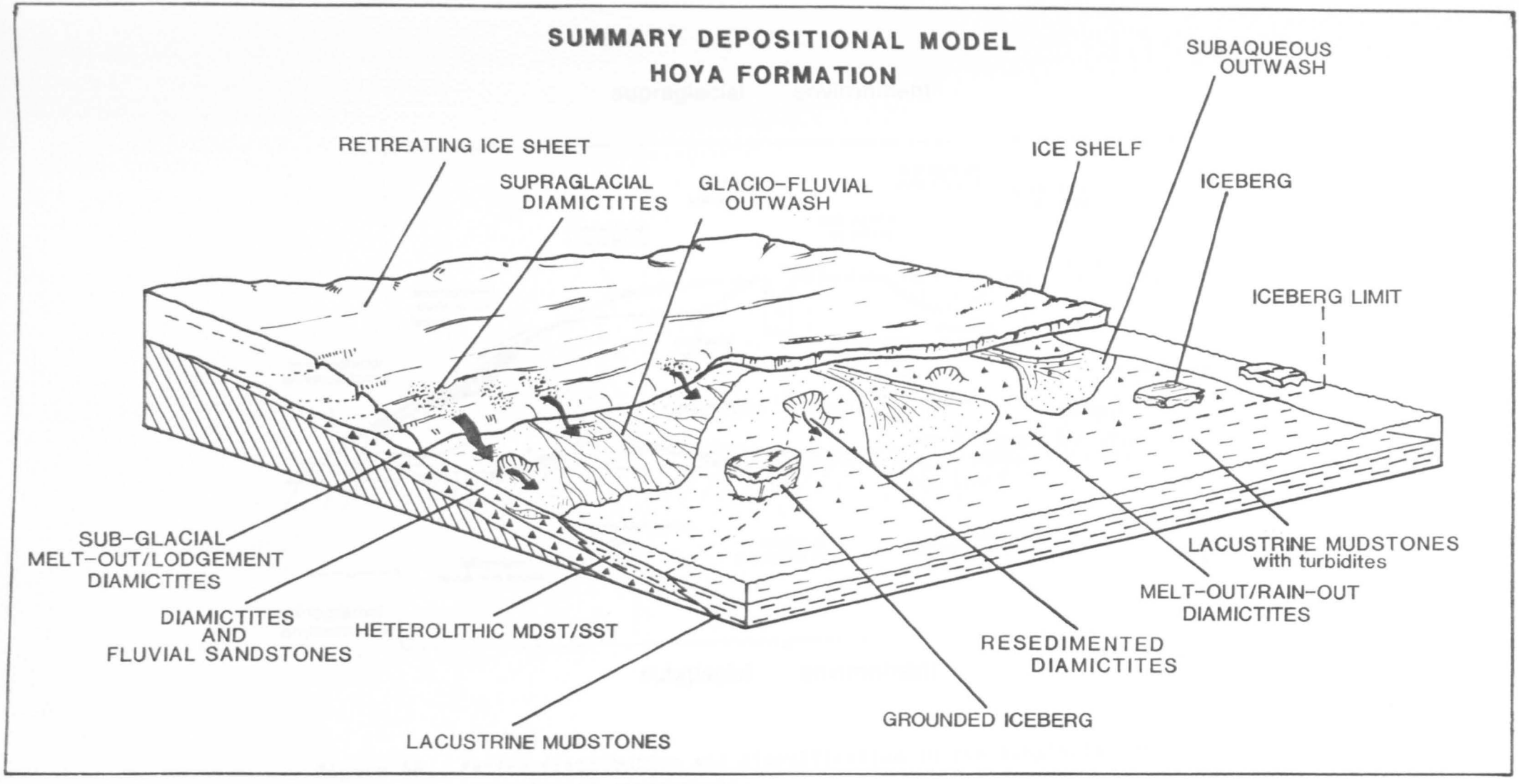


Figure 67. Summary depositional model for the Hoya Formation.

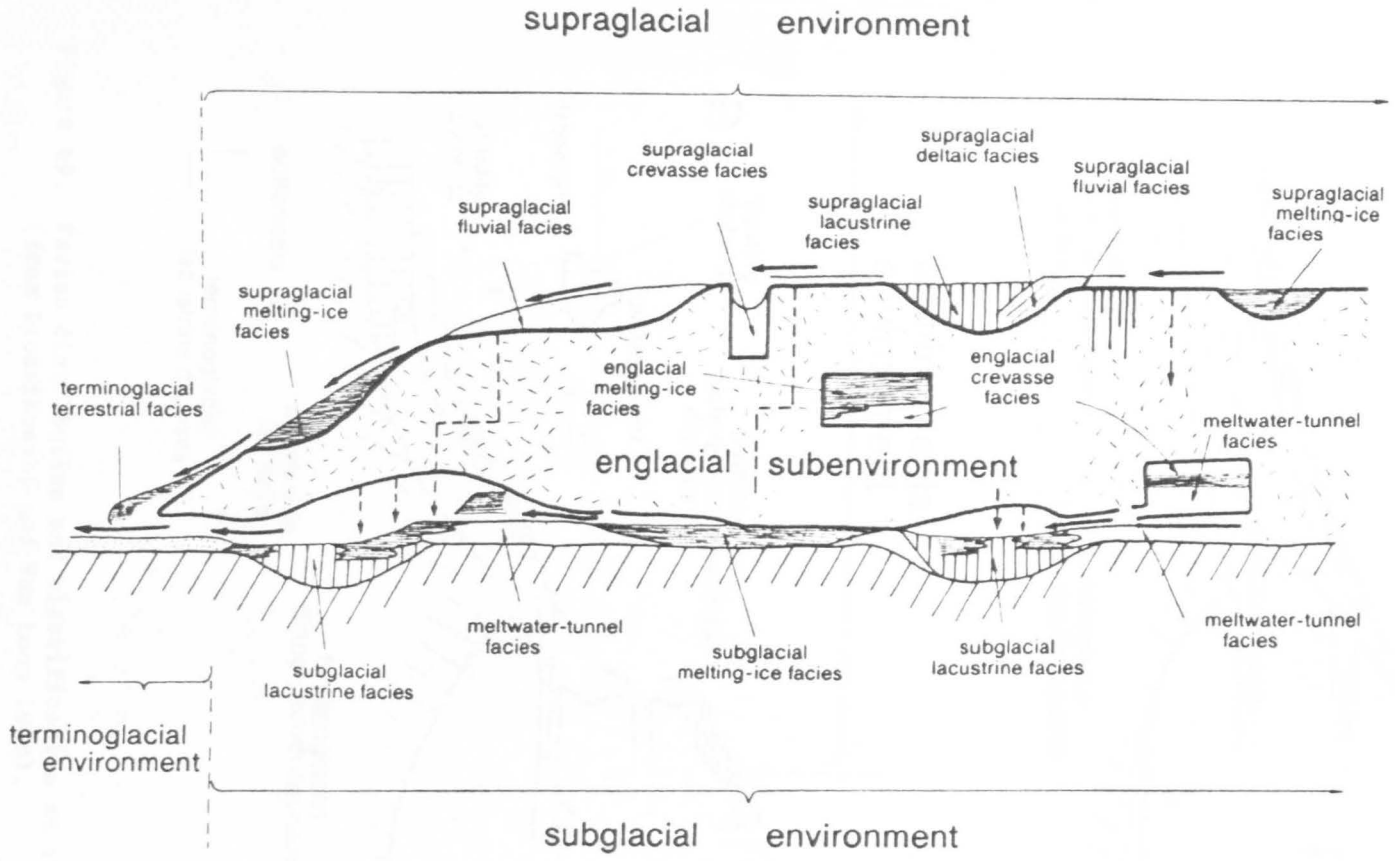


Figure 68. Facies distribution and classification in the subglacial and supraglacial environment.
(modified from Brodsikowski and Van Loon 1988)

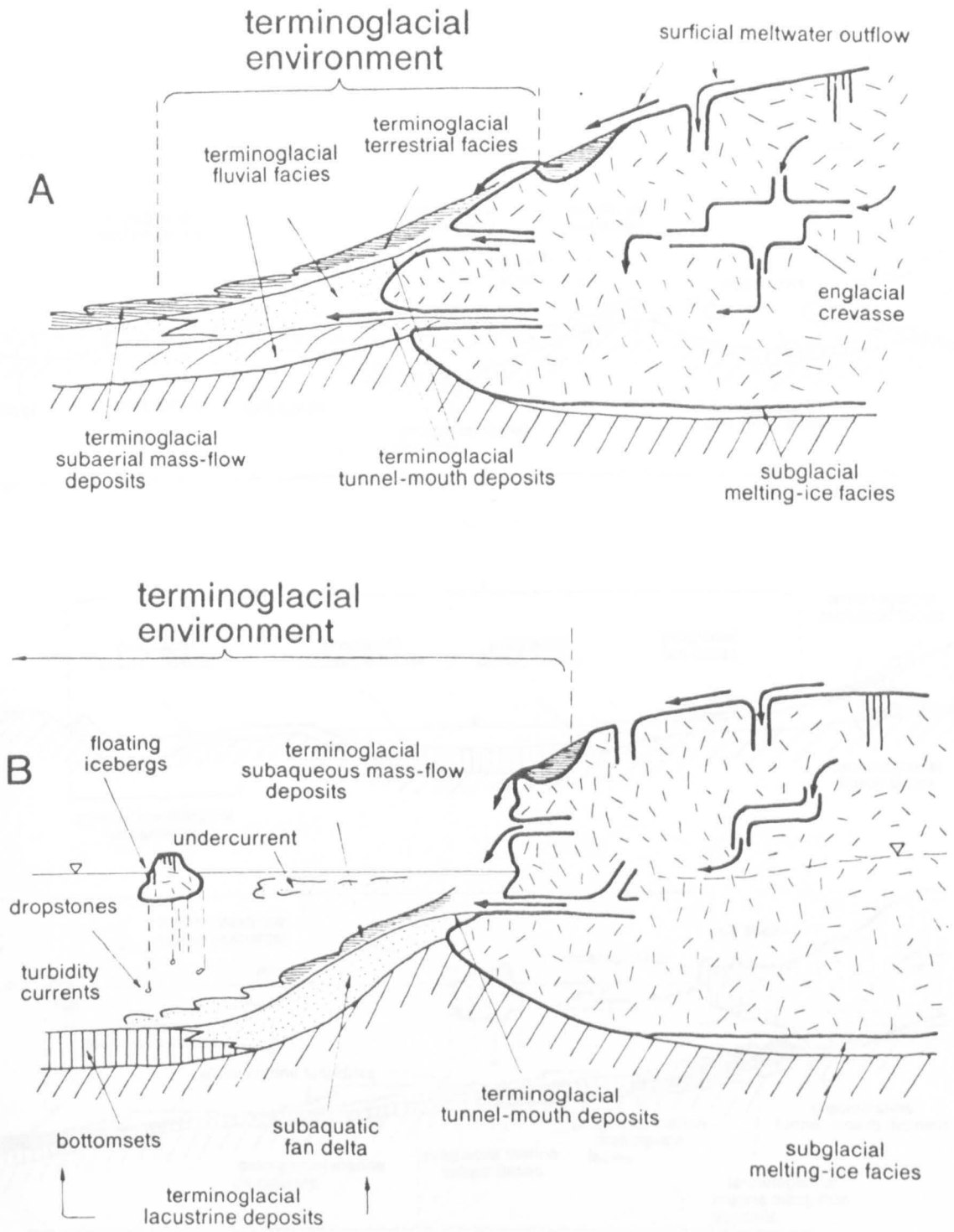


Figure 69. Facies distribution and classification at the margins of an ice sheet. (from Brodsikowski and Van Loon 1988).

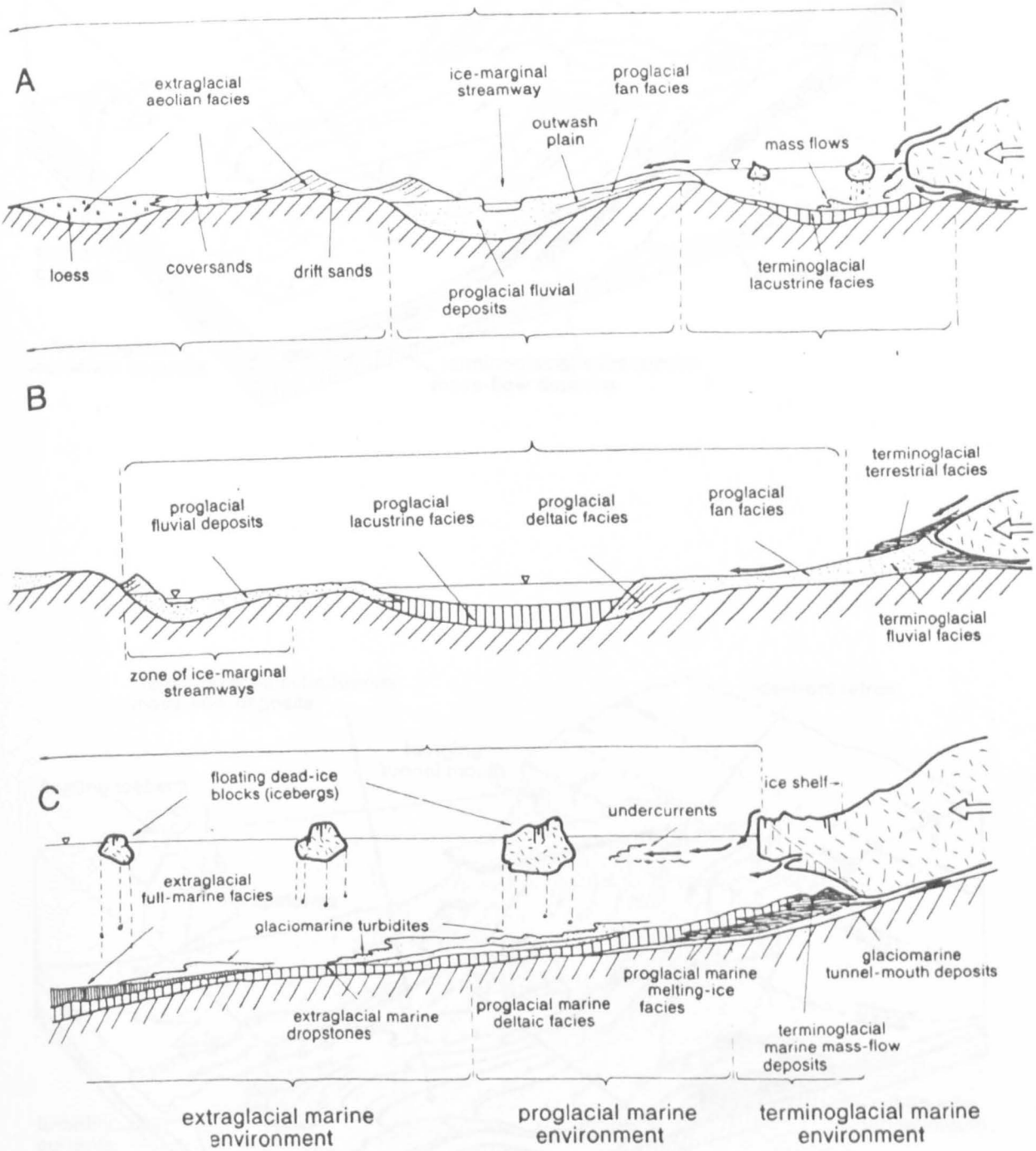


Figure 70. A schematic representation of the wide variety of facies deposited proximal to an ice sheet.
A. Terrestrial environment with ice contact lakes.
B. Terrestrial environment without ice contact lakes.
C. Subaqueous environment, with the ice sheet in contact with the basin, either under marine or lacustrine conditions.
(modified from Brodsikowski and Van Loon 1988)

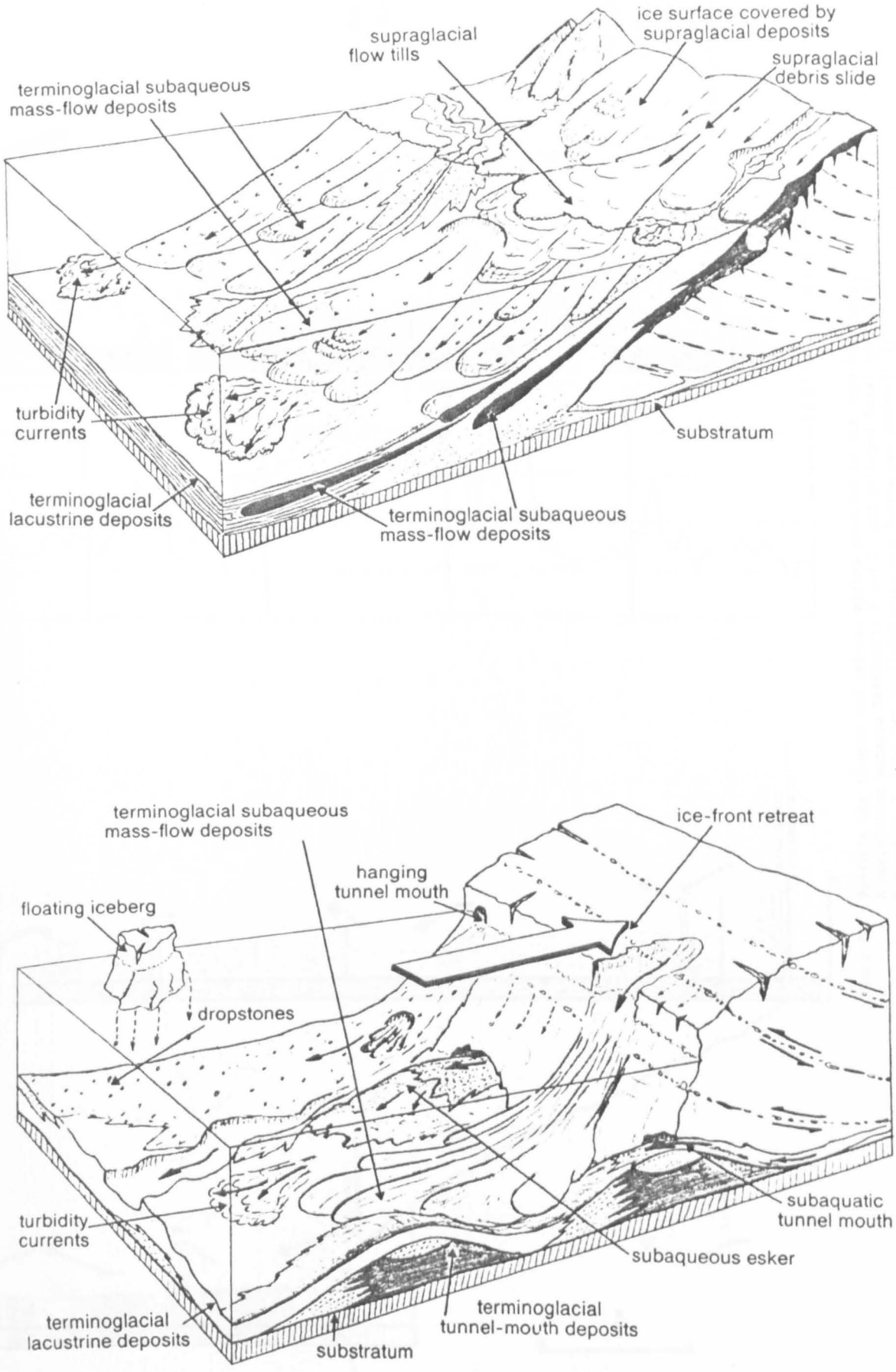


Figure 71. Two models for ice marginal sedimentation.
A. A downwasting ice front.
B. Rapidly retreating ice sheet in contact with marine/lacustrine conditions.
Note in both cases the proposed rapid lateral and distal facies changes and the complex distribution of facies.
(from Brodsikowski and Van Loon 1988)

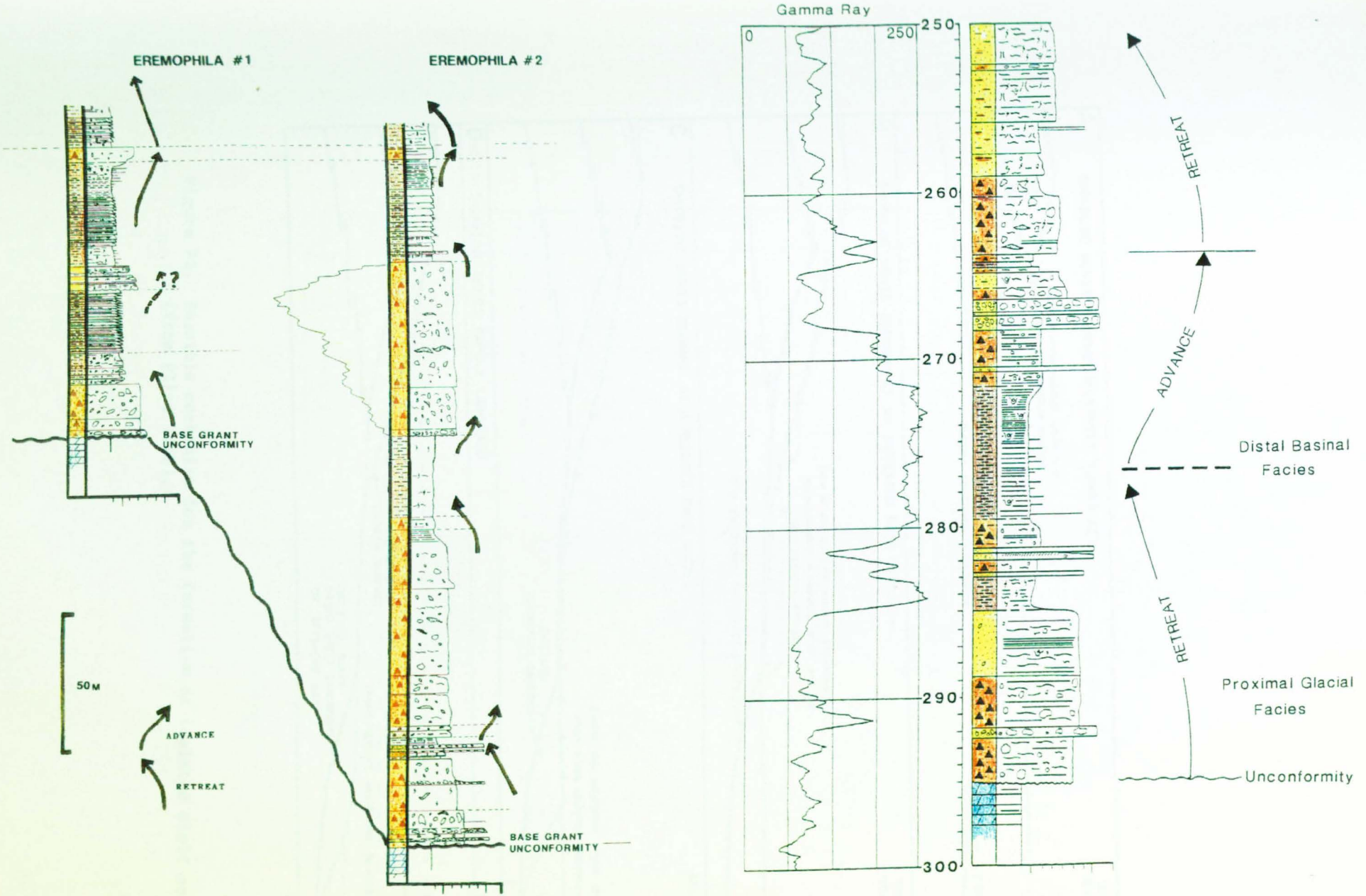


Figure 72. Possible ice advance and retreat cycles recorded in the Hoya Formation. A correlation between Eremophila 1 and 2, and enlarged basal section of Eremophila 3. (For key to lithologies and facies see Appendix 1)

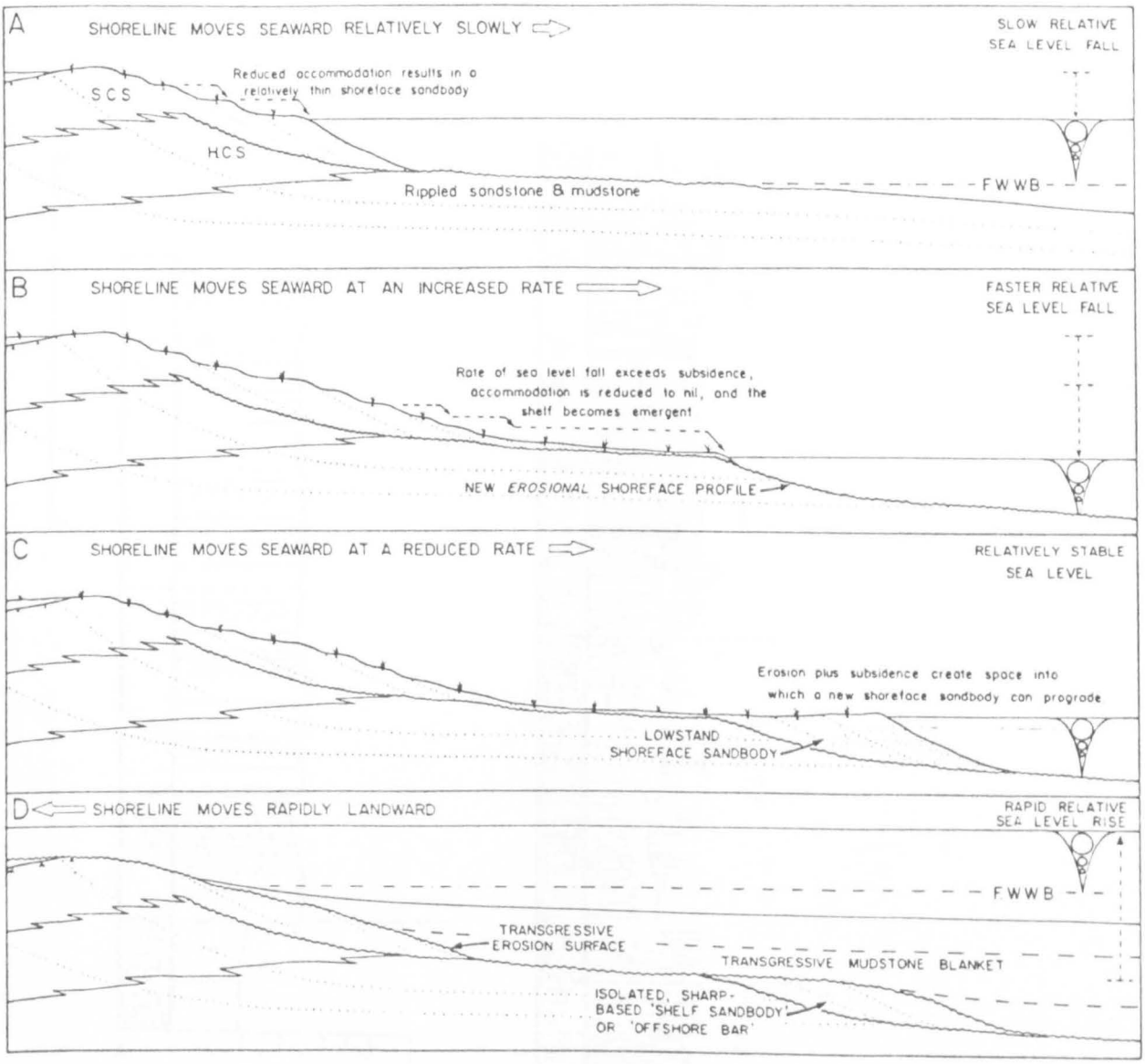


Figure 73. Possible mechanism for the formation of isolated shelf sandbodies. (from Plint 1988).

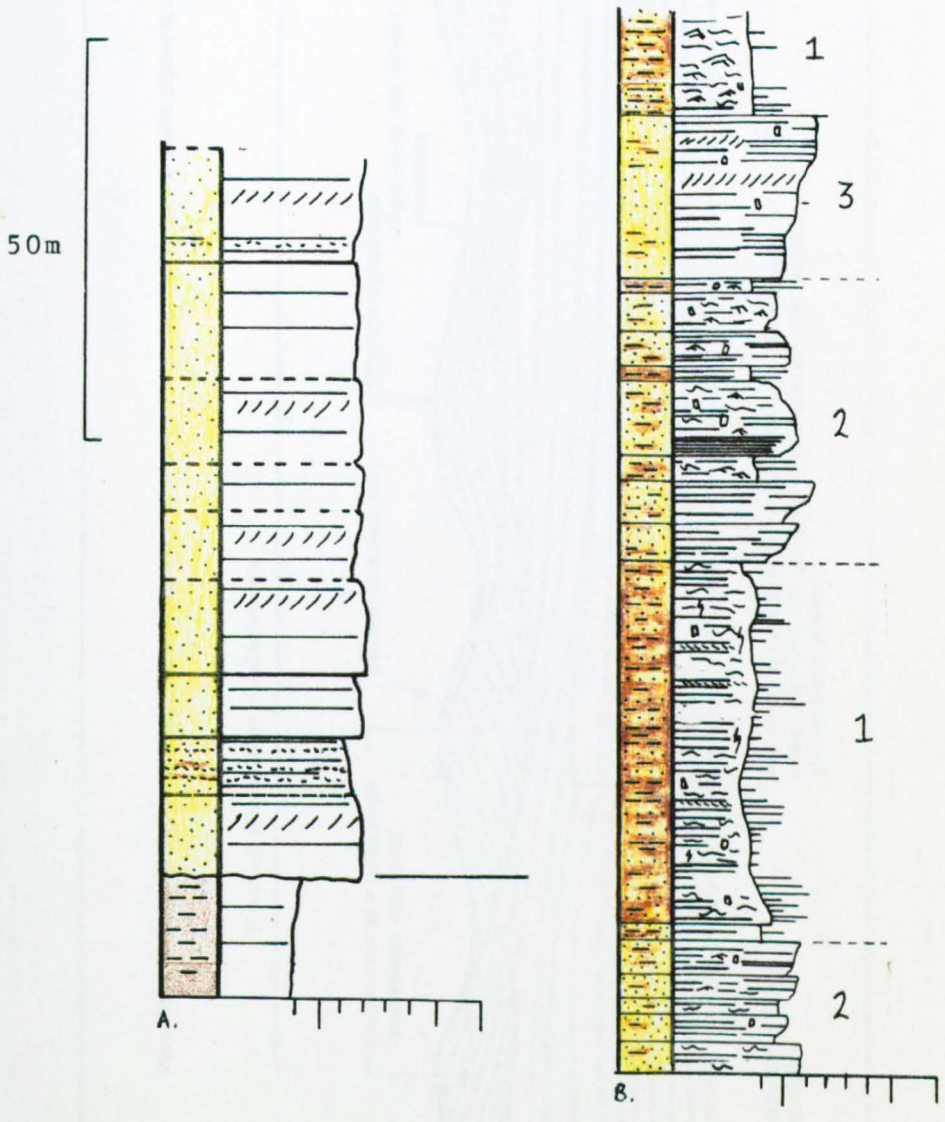


Figure 74. Typical facies logs for the Clianthus Formation.
A. Sandstone facies
B. Heterolithic facies.

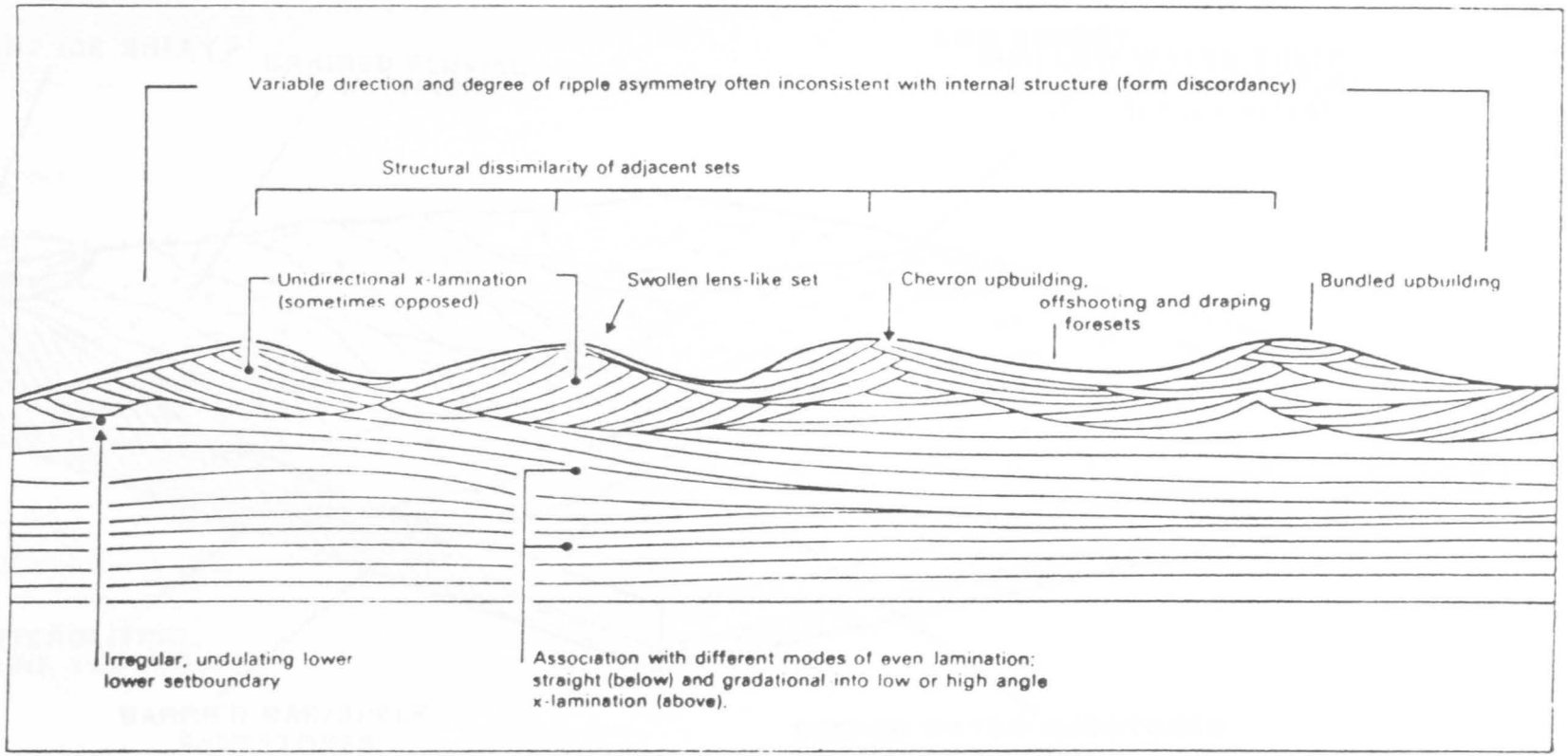


Figure 75. Characteristics of wave-generated ripples. (from Reading 1981, after De Raaf et al. 1977.

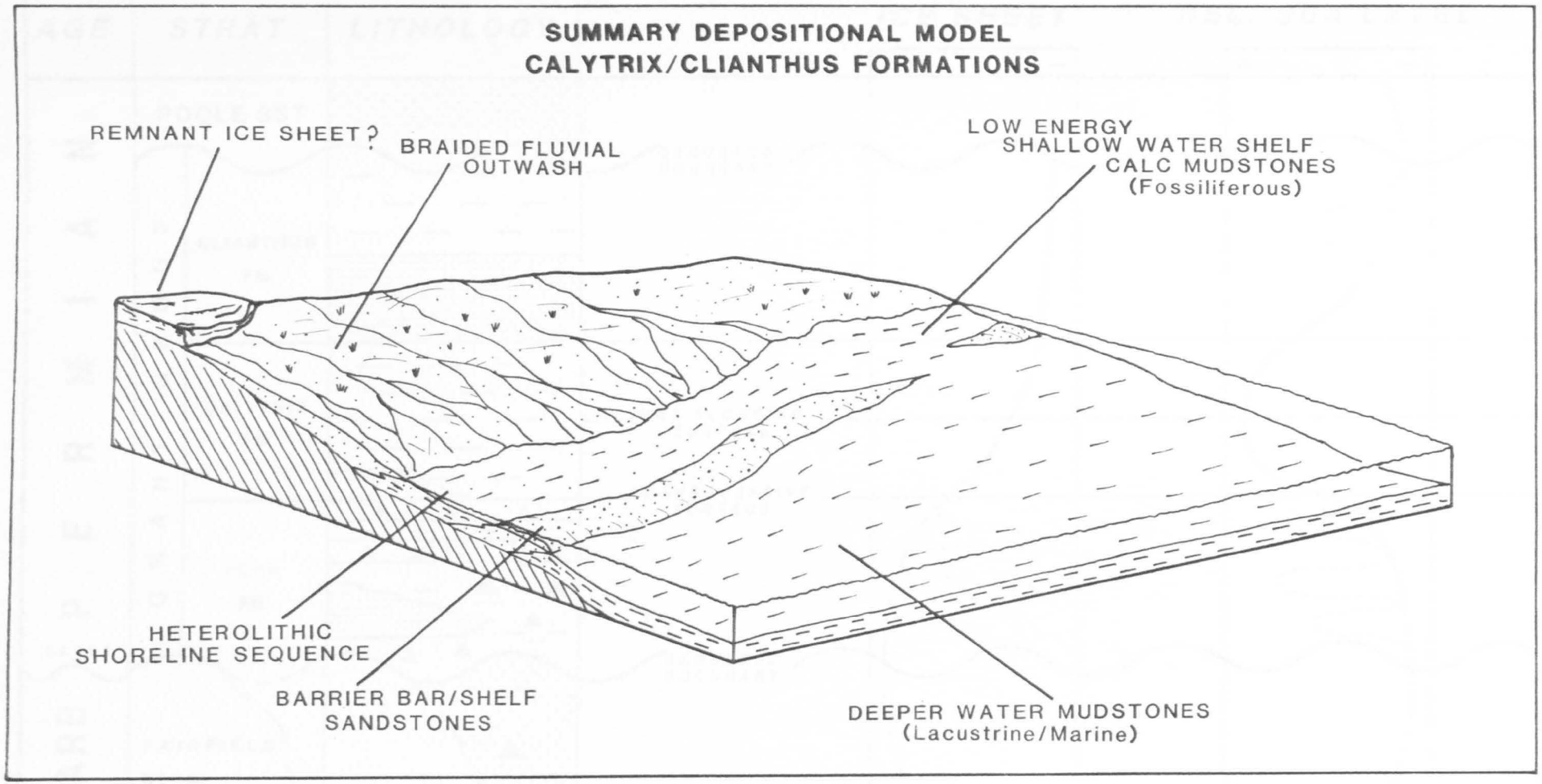


Figure 76. Combined summary depositional model for the Calytrix and Clianthus Formations.

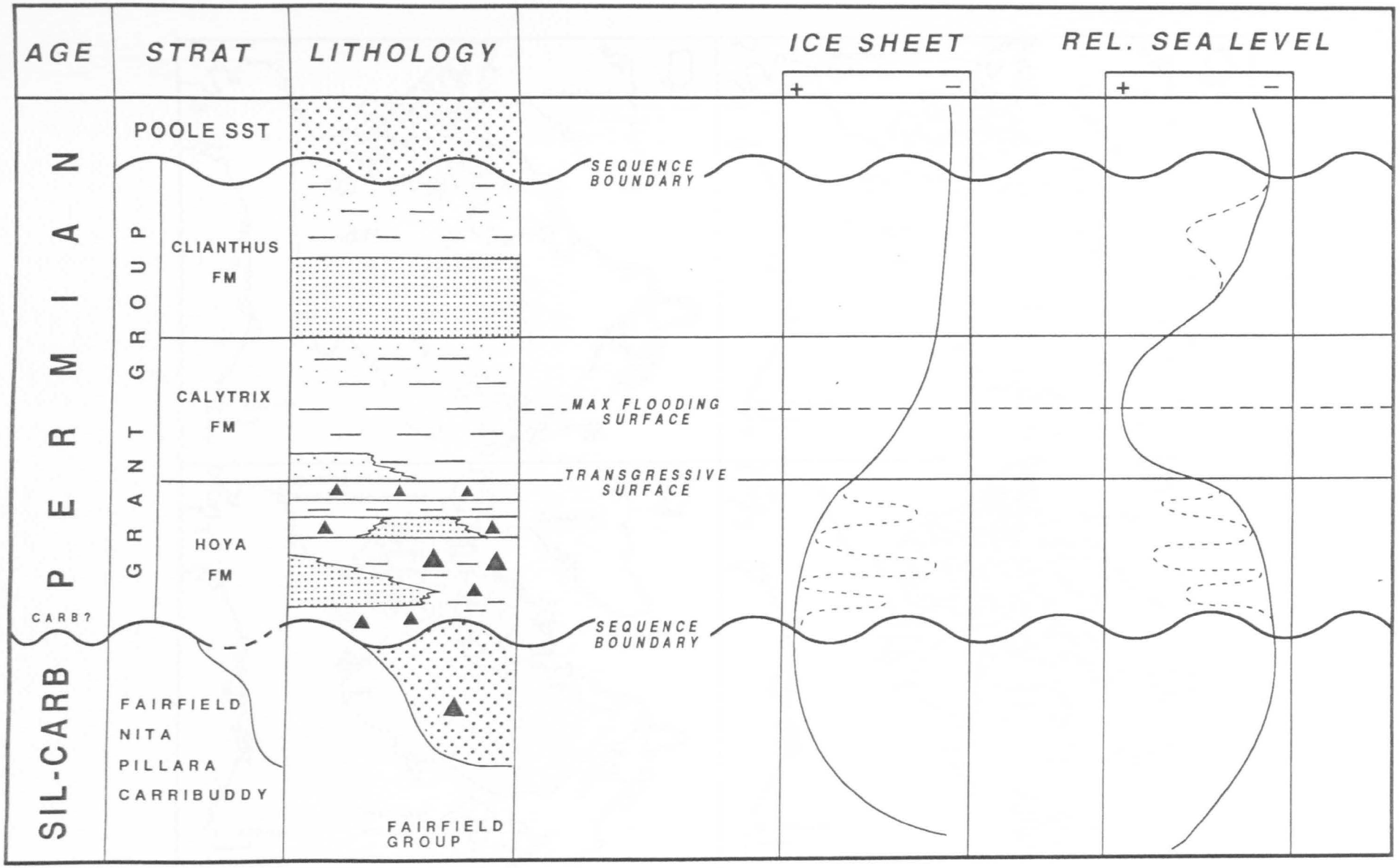


Figure 77. A model for the evolution of the Grant Group sedimentary package in relation to the ice sheet dynamics and changes in relative sea level.

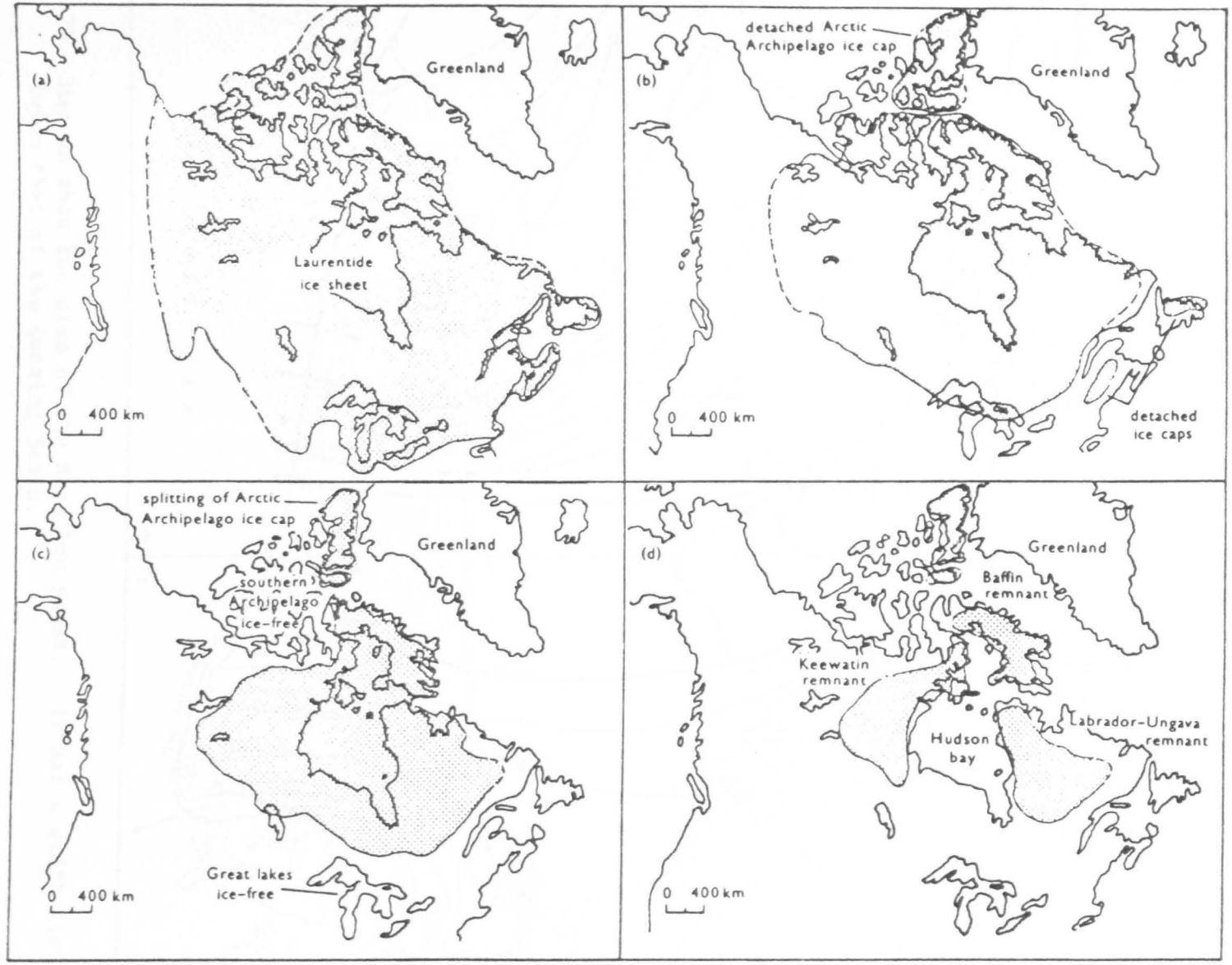


Figure 78. Map showing the various stages in the retreat of the Laurentide ice sheet. (a) 13,000yrs BP (b) 10,000yrs BP (c) 8000yrs BP (d) 7000yrs BP (from Sugden and John 1985, after Bryson et al. 1969)

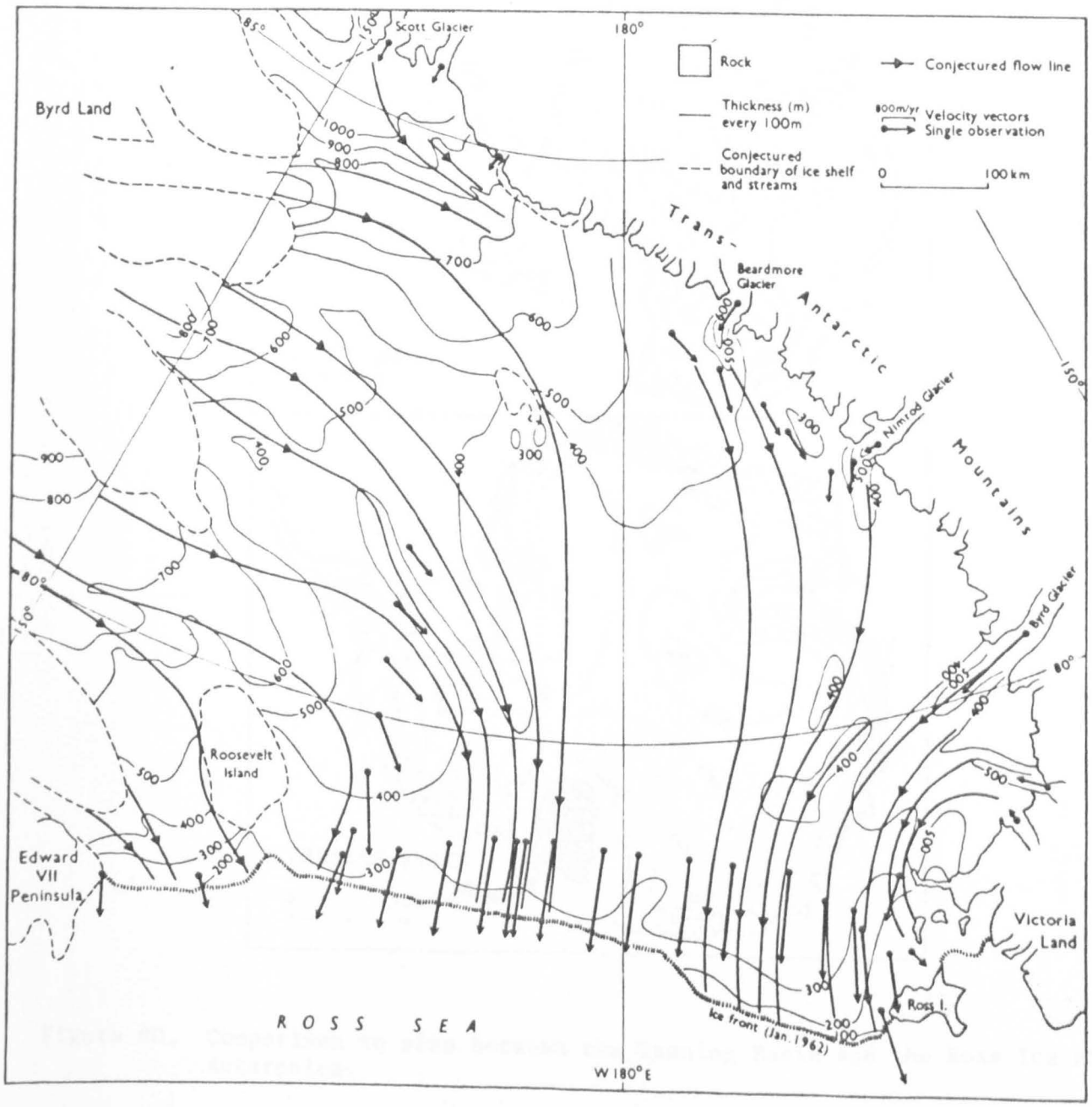


Figure 79. Map to show the size of the Ross ice sheet. It has a width almost twice that of the Canning Basin.

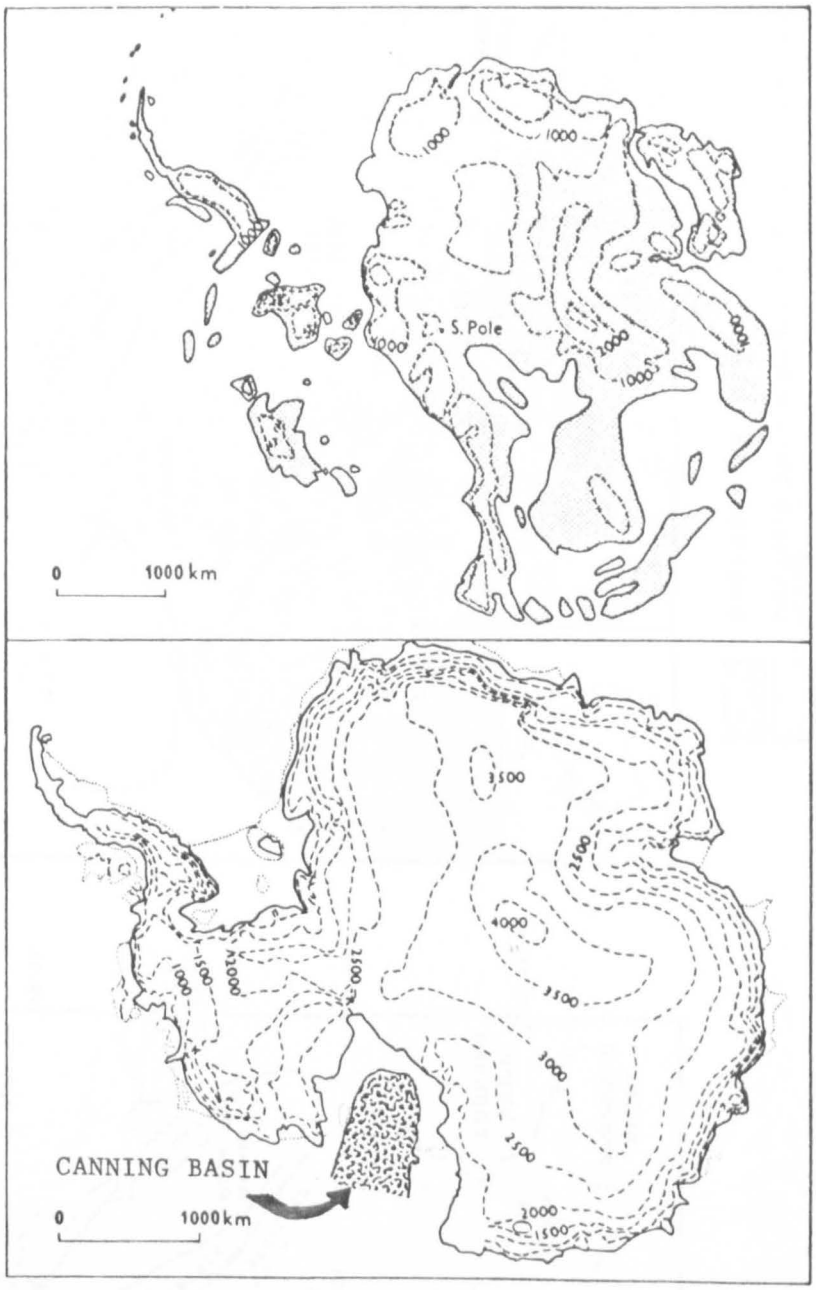


Figure 80. Comparison in size between the Canning Basin and the Ross Ice shelf of Antarctica.

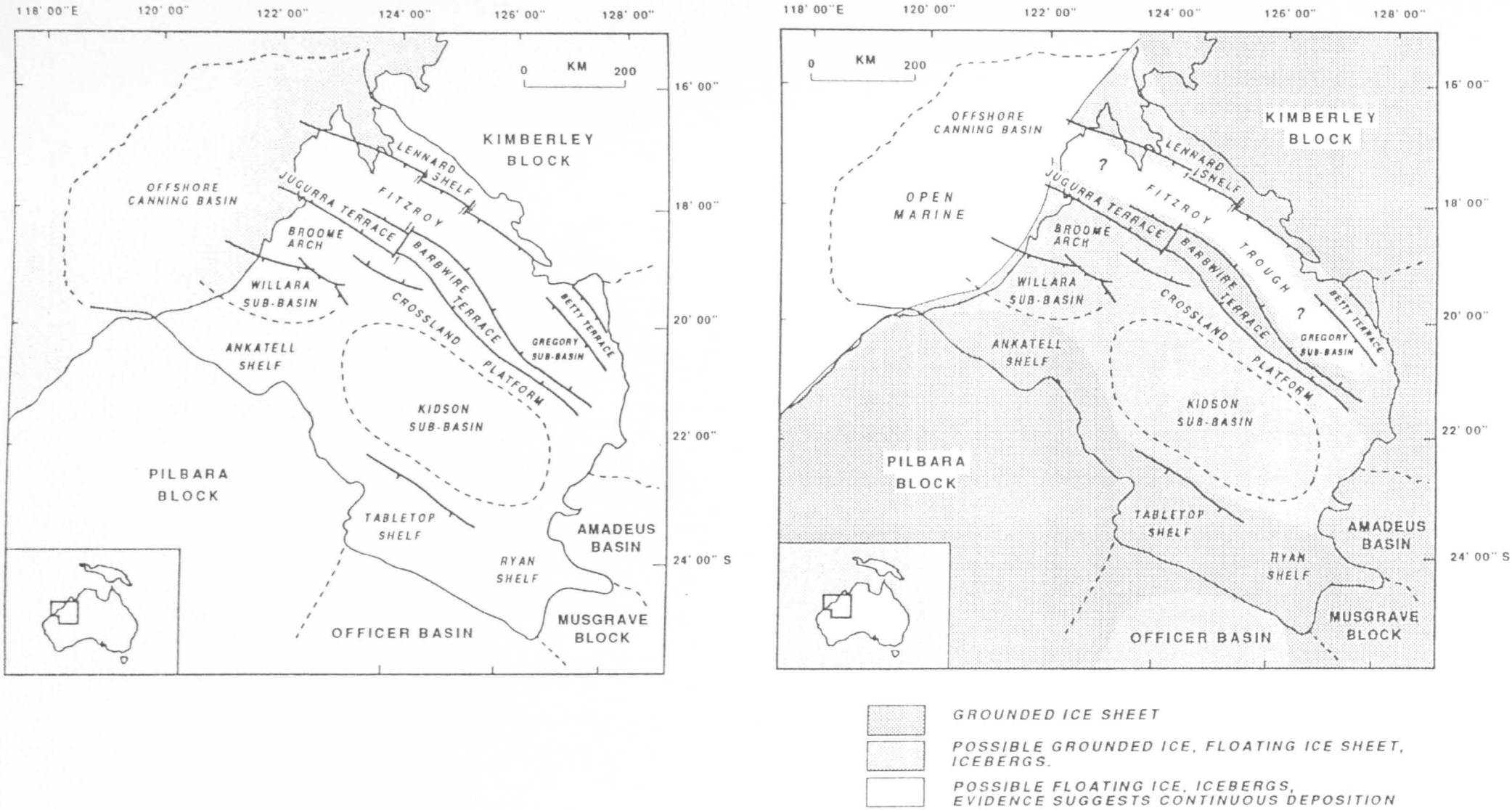


Figure 81. Schematic model for the distribution of ice in the Canning Basin area during the Perm-Carboniferous

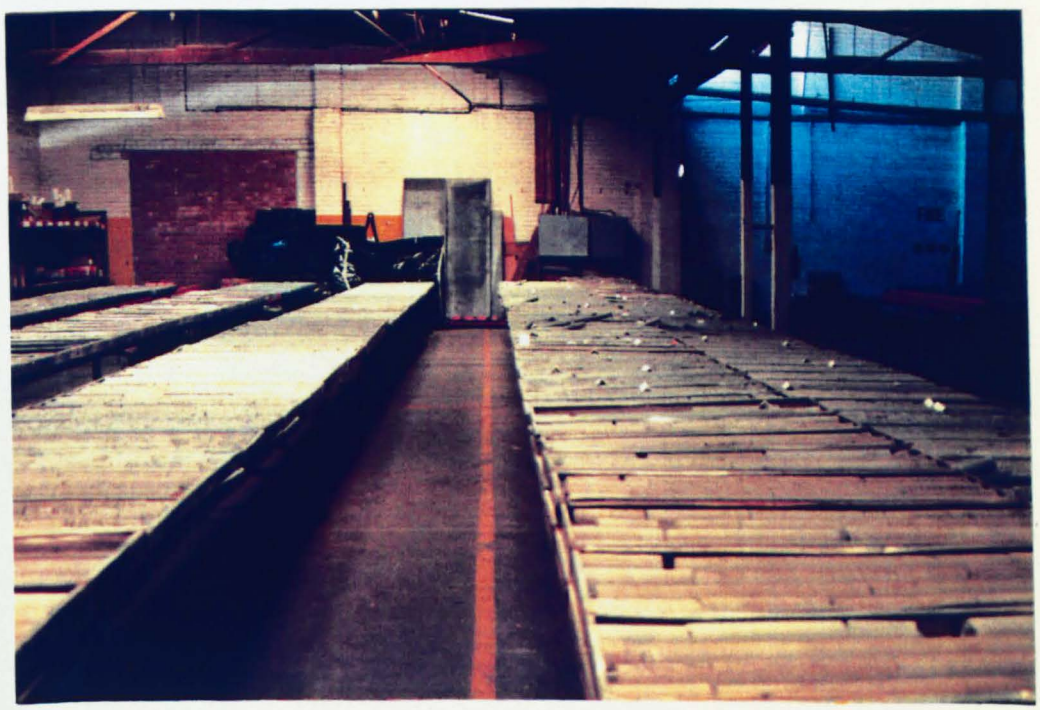
PLATES

PLATE 1

A. Landsat composite image of Australia with computer enhanced colours; green-brown indicate wet vegetated areas, light brown to white indicate dry desert areas. The Great Sandy Desert covers most of NW Australia, overlying the Canning Basin.

B. The 'Challanger Geological Services' core store, where Western Mining's Canning Basin core was viewed. Each tray contains 5m of core, cut into 1m lengths.

A

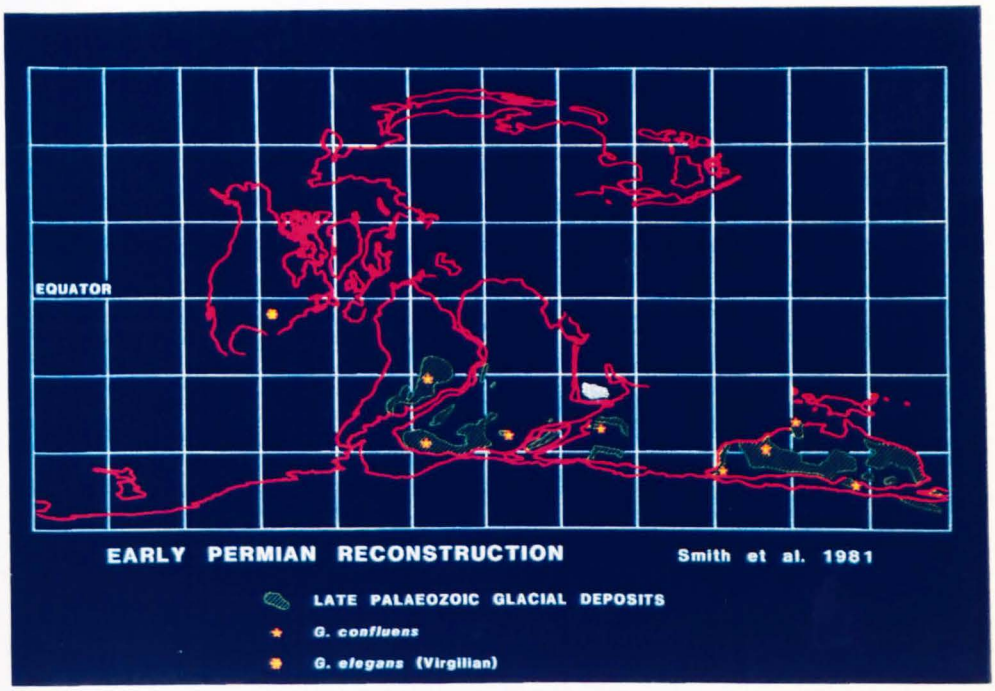


B

PLATE 2

A. Early Permian palaeogeographic reconstruction of Gondwana and Eurasia, highlighting areas of known glacial deposits, and the occurrence of the G.confluens assemblage. (Courtesy of C. Foster, Western Mining Corporation Ltd.)

B. Alternative projection of the Gondwanan continent during the Early Permian. The G.confluens assemblage has been recognised in glacial sediments from Brazil, South Africa, India and numerous basins in Australia, confirming the age equivalence of these deposits. (Courtesy of C. Foster, Western Mining Corporation Ltd.)


EQUATOR
EARLY PERMIAN RECONSTRUCTION
Smith et al. 1981
LATE PALAEOZOIC GLACIAL DEPOSITS
G. confluens
G. elegans (Virgilian)

A


G. CONFLUENS
? G. CONFLUENS
Goniatites
Other Fauna
GLACIAL OUTCROP
LATE PALAEOZOIC BASINS
GONDWANA DISTRIBUTION OF G. CONFLUENS

B

PLATE 3

Fence diagram showing the BMR correlation between the older wells surrounding the study area. The Barbwire Terrace is bounded by the Fenton and Dummer Range Faults, and the study area lies between the well Crossland 3 to the south and Barbwire 1 to the north. Note the interpreted anticline on which St George Range 1 is located. (from BMR Noonkanbah Sheet SE51-16 1977)

Subsurface Correlation

Scale : $\frac{V}{H} = 5$

Symbols as in reference except:

- J — *Undivided Jurassic*
- R — *Undivided Triassic*
- *Fault plane*

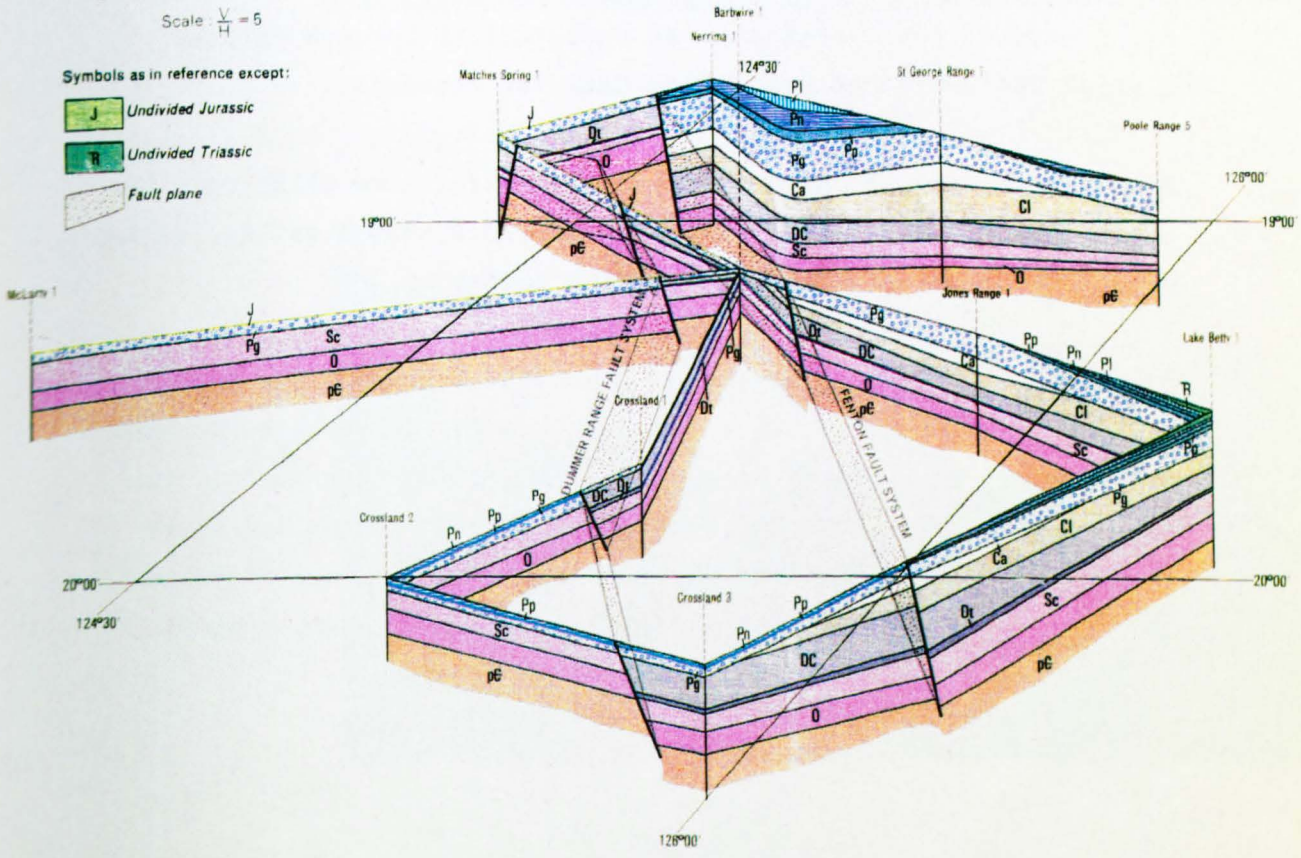


PLATE 4

HALLETT COVE, SOUTH AUSTRALIA

A. A view of the marked angular unconformity between Permian glacial sediments and the folded Cambrian sequence.

B. Another view of the unconformity surface. The cliff face in the background contains a glacially eroded U-shaped valley, filled with lighter coloured Permian glacial sediments.

C. Glacial striations on the unconformity surface. The deep linear grooves were cut into the Cambrian surface by a hard clast embedded in the base of the over-riding grounded ice sheet. The grooves vary in orientation suggesting changes in the ice sheet flow direction and multiple phases of grounding. Less distinct chatter-marks, partially filled with loose beach sand, suggest a transport direct towards the right of the picture.

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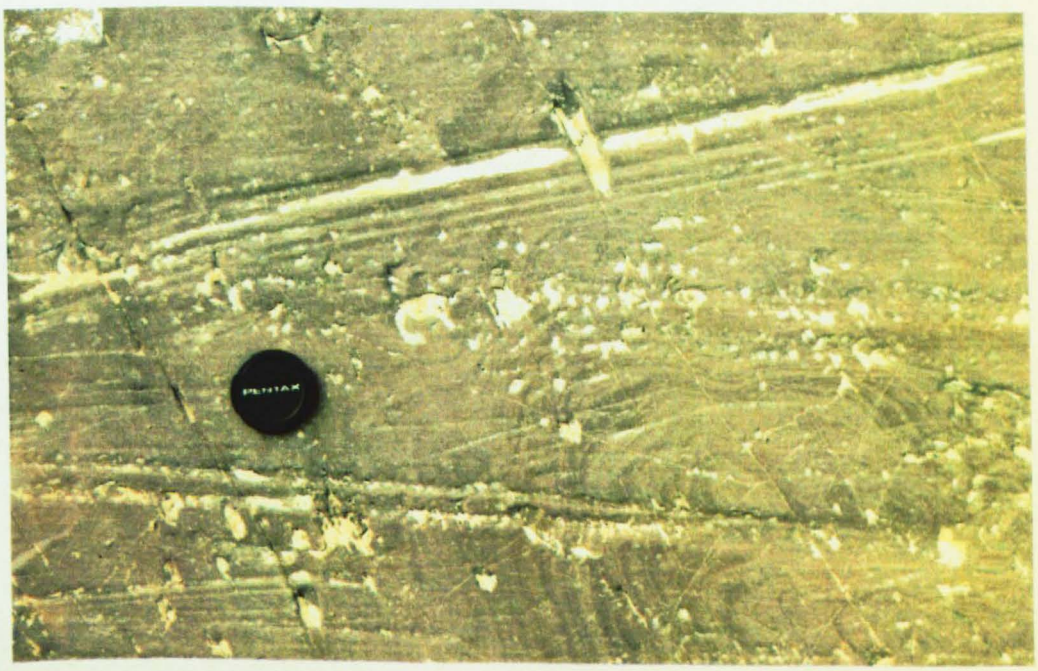


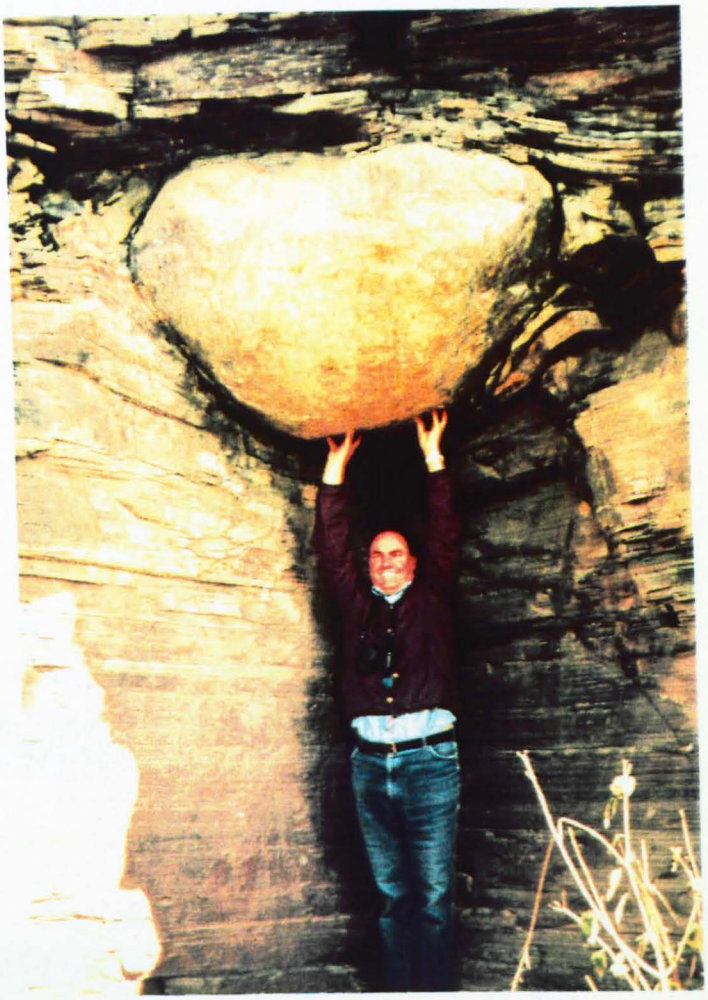
PLATE 5

PARANA BASIN, SOUTHERN BRAZIL

A. A large dropstone within a suite of laminated mudstones, from the Itarare Group, the Parana Basin, Brazil. The underlying sediments have been deformed by the sudden impact of the dropstone, with folding of the laminations. Continued deposition of the mudstones drape the large clast.

B. Close up of folding and soft-sediment deformation associated with the sudden impact. The clast is interpreted to have been released from a floating iceberg within the basin.

In core, the deformation commonly apparent in the Grant Group sediments may in part be due to impacts of this kind. Large clasts were cored from diamictite and mudstones lithologies, although the limitation of the core size prevents clear identification of loading features such as seen here.



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B

PLATE 6

A. Hoya 1 433.80m (Hoya Formation)

The basal unconformity between the Grant Group and underlying Devonian siltstones. The upper 5cm of the Devonian section is brecciated indicating possible loading and shearing by the grounded ice sheet, or weathering, prior to the deposition of the Basal Diamictite of the Grant Group. Facies BD comprises a sandy diamictite containing abundant large angular dolomitic limestone clasts (similar to the Devonian subcrop of the area) and less common basement clasts.

B. Eremophila 2 228.05m (Hoya Formation)

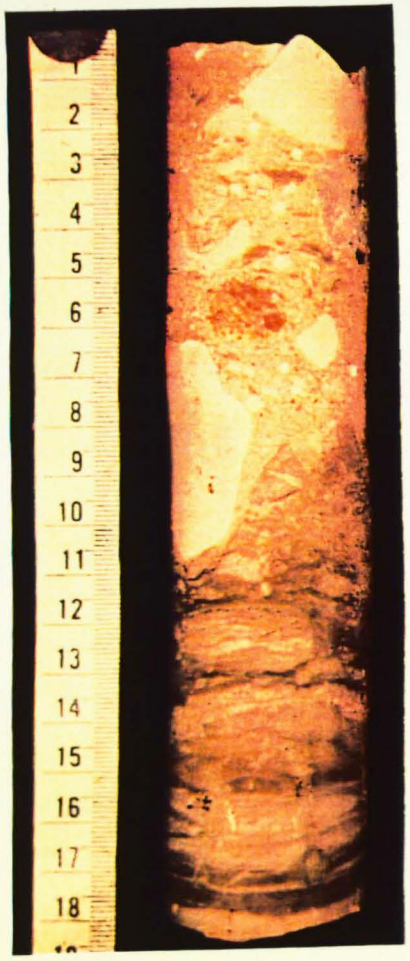
A clast-rich sandy diamictite of facies BD. Large dolomitic limestone clasts float in a light-brown sandy matrix. The clasts are angular, and often appear to be facetted. (4.5cm core)

C. Eremophila 3 292.10m (Hoya Formation)

Another example of the basal diamictite, this time containing more abundant basement clasts, often rounded to subrounded. The diamictite is sandy and clast-rich. (6.5cm core)

D. Eremophila 1 195.50m (Hoya Formation)

Located above a clast-rich diamictite similar to (A), this sandy diamictite contains contorted bedding in the lower section, picked out by darker, slightly more argillaceous streaks and wisps. This suggest a primary bedding, distorted by subsequent soft-sediment deformation and slumping. The diamictite is interpreted to be a melt-out till, which has undergone some remobilisation. (6.5cm core)



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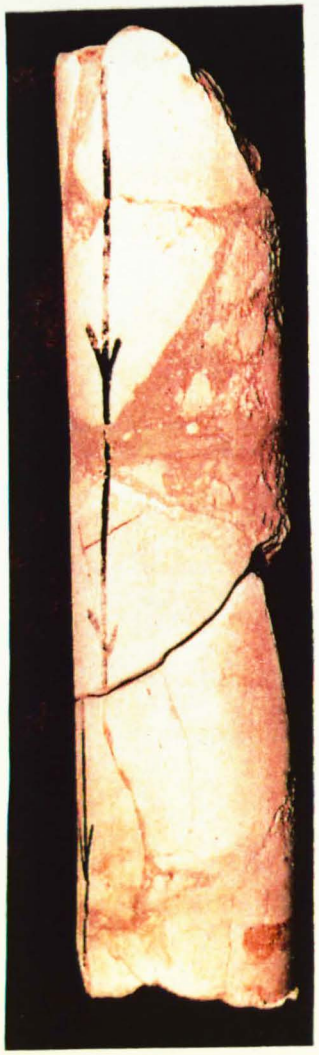

B

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D

PLATE 7

A. Halgania 1 304.10m (Hoya Formation)

A clast-rich sandy diamictite from the Basal Diamictite Association. Note the abundant angular clasts of locally derived dolomitic limestone. (4.5cm core)

B. Eremophila 1 191.50m (Hoya Formation)

The abrupt upper contact between a sandy diamictite of the Facies BD, and a heterolithic unit comprising laminated silts, muds and very fine-grained sandstones. The heterolithic unit contains complex lensoid and wispy bedding, which suggests subaqueous deposition and subsequent intense soft-sediment deformation. A small basement clast, denoted by the arrow, is possibly a dropstone. (6.5cm core)

C. Eremophila 3 223.10m (Hoya Formation)

A massive sandy diamictite of Facies DSm. Scattered clasts of dolomitic limestone in a light brown sandy matrix. Basement clasts are rare. This resembles the diamictites of Facies BD, and is interpreted to be a melt-out or possibly lodgement tillite. (6.5cm core)

D. Eremophila 2 185.96m (Hoya Formation)

The sharp upper contact between a sandy diamictite (Facies DSm) and overlying mudstones of Facies Fl. The sharp contact indicates either a rapid change in the depositional environment, or that the diamictite has moved by mass-flow processes into the basinal environment, and is thus a flow till. (6.5cm core)

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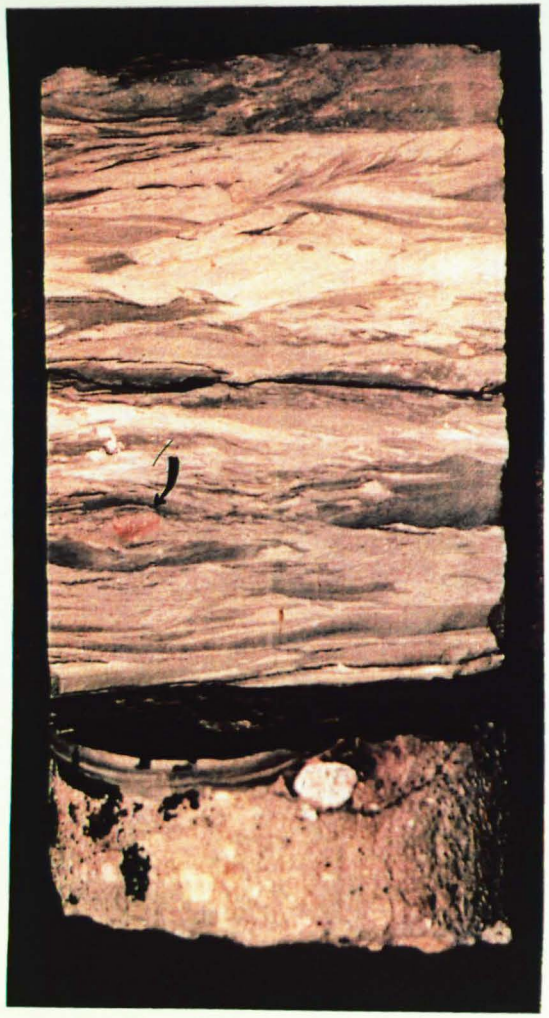

B

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PLATE 8

A. Eremophila 2 205.60m (Hoya Formation)

The transition from a massive muddy diamictite (DMm) to a laminated mudstone (Fl). Layers become evident within the 'massive' diamictite that contain a lower percentage of coarse material, and this continues up section. The 'diamictite' layers both reduce in thickness and becoming more argillaceous, until the sequence grades into a mudstone. This is clear evidence that this diamictite was deposited under subaqueous 'basinal' conditions.

B. Eremophila 3 258.70m (Hoya Formation)

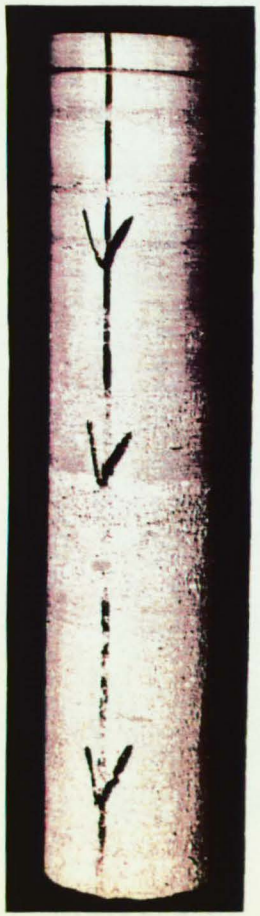
The upper section of a sandy diamictite (Facies DSs), displaying intense soft-sediment deformation, with folded and contorted bedding. The lighter coloured sandstone streaks comprise are similar to thinly bedded sandstones overlying this diamictite. The deformed character of this diamictite indicates remobilisation.

C. Eremophila 3 220.95 (Hoya Formation)

A lens of fine-grained sandstone within a sandy diamictite. The lens displays high-angle contacts, and is possibly a small channel. It incorporates clasts of the diamictite, and basement and dolomitic limestone clasts derived from the diamictite. The feature appears to be deformed and loaded.

D. Calytrix 1 263.60m (Hoya Formation)

Part of a complex sequence of interbedded sandy diamictites and sandstones (Facies DSs). The lower 5cm is the top of a sandy diamictite, which is cut by an erosively based sandstone. The sandstone grades from a coarse conglomeratic base up to medium-grained sandstone. The conglomeratic clasts are of a similar composition to clasts from the diamictite. This is interpreted to be a melt-water channel deposit cutting and reworking the diamictite. This could form in either subaerial or subaqueous conditions



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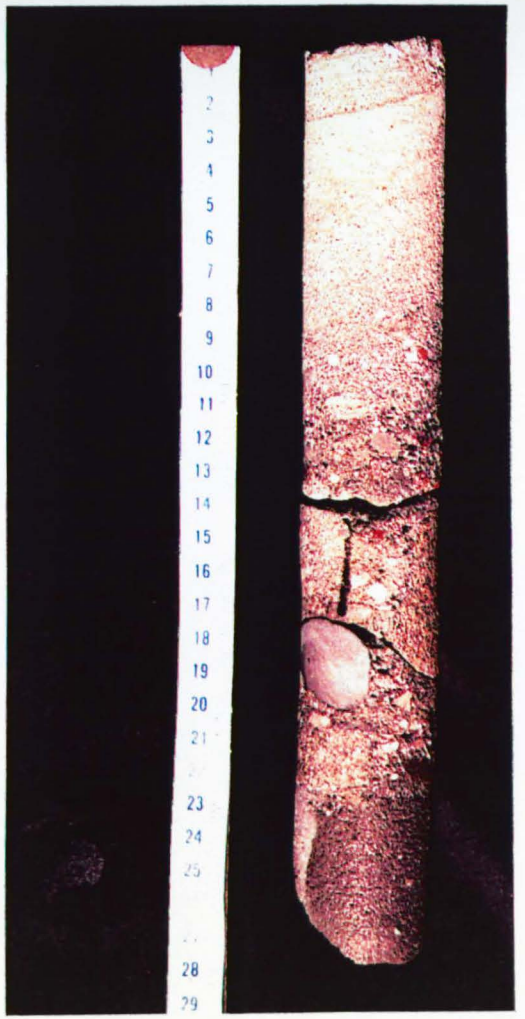

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PLATE 9

A. Calytrix 1 281.20m (Hoya Formation)

A typical massive muddy diamictite(DMm), containing scattered clasts, introduced as dropstones released from floating icebergs. The diamictite is interpreted to be a 'rain-out' deposit. (4.5cm core)

B. Diagrammatic representation of the 'rain out' depositional environment. Icebergs, moved by basin currents or wind, slowly melt and release the trapped englacial debris. In addition, normal sedimentation of mud and silt from suspension provides the dominant muddy matrix.

C. Outcrop of similar muddy diamictite from the Itarare Group of the Parana Basin, Brazil. Evidence from outcrop suggests that these diamictites are commonly laterally extensive and grade into normal basinal mudrocks, supporting a subaqueous 'rain-out' origin.

A

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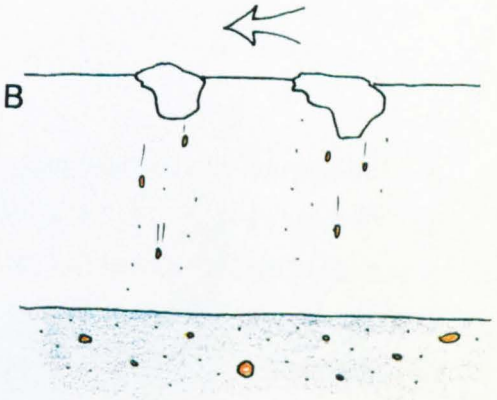

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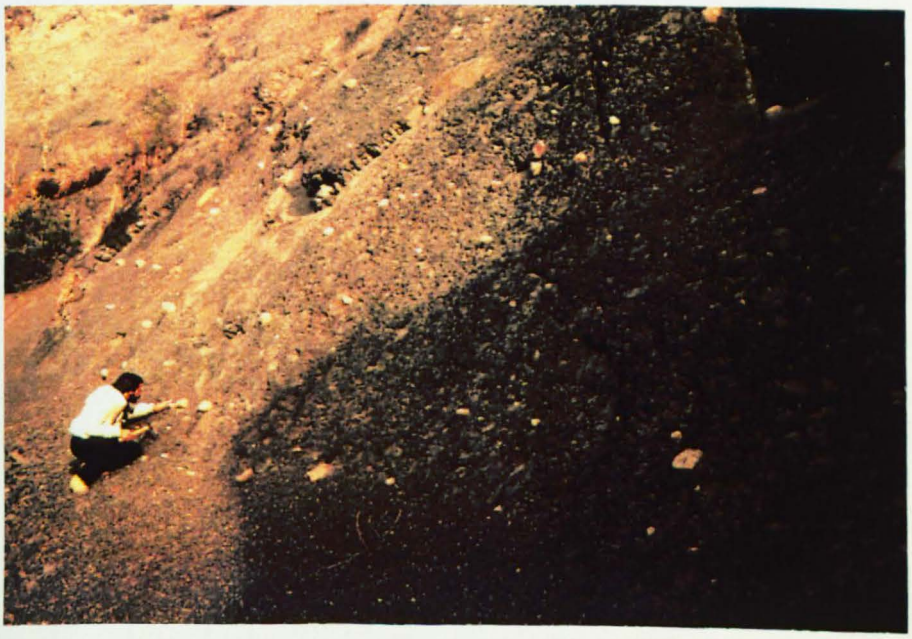


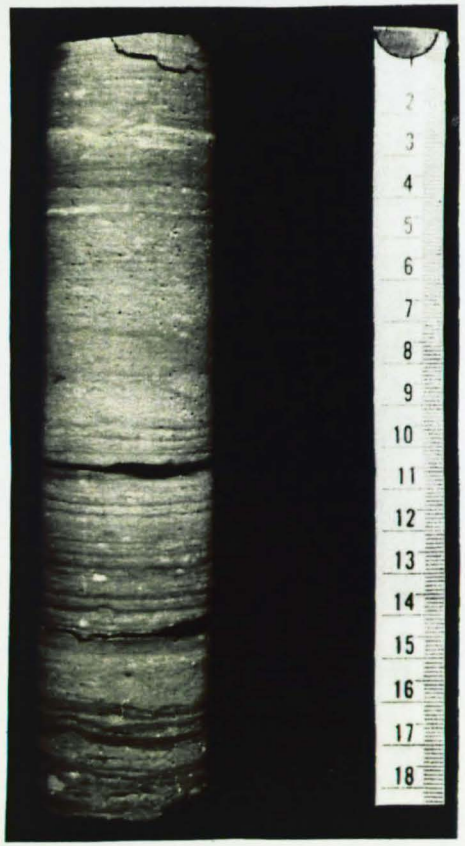
PLATE 10

A. Halgania 1 229.85m (Hoya Formation)

The gradual upward transition from a laminated mudrock (Fl) to a massive muddy diamictite (DMm). Thin layers rich in small diamictite clasts grade into layers of diamictite composition, which become thicker and more frequent, until the bedded nature is lost and the diamictite appears to be massive. This suggests a subaqueous origin for the diamictite, and is taken to indicate an ice advance sequence.

B. Halgania 1 230.30m (Hoya Formation)

Close up of the base of the transitional unit, which contains clasts of diamictite composition within the laminated mudrock. The clasts are interpreted to be transported by floating ice into the basinal setting.



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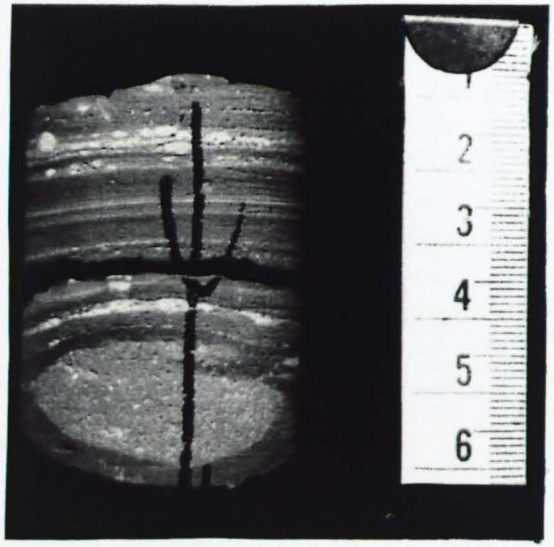


B

PLATE 11

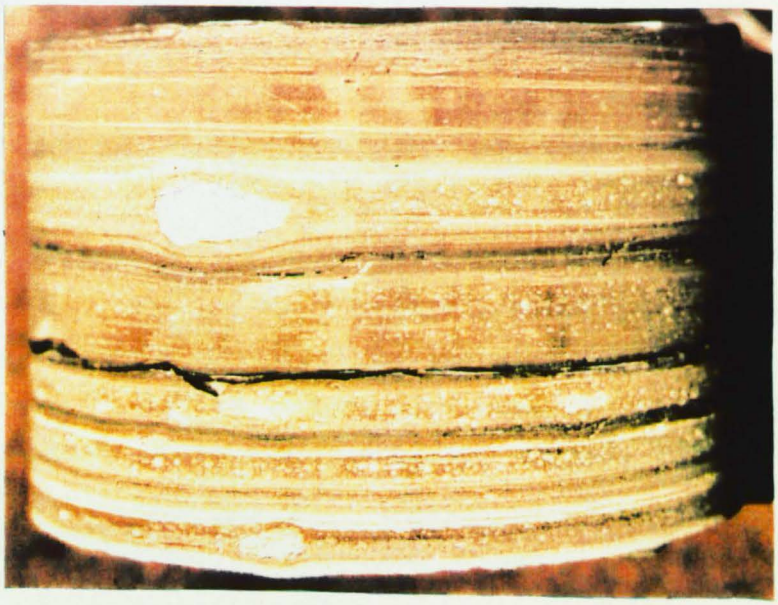
A. The Itarare Group, Parana Basin, Brazil.

A thinly bedded mudrock containing abundant small clasts. Individual layers comprise a light grey multi-graded basal siltstone overlain by a thin dark mudstone. Clasts are angular and scattered throughout. (Width of photograph approx. 25cm)

B. **Eremophila 1 175.85m (Hoya Formation)**

Similar bedded mudrock from the Grant Group, with couplets comprising a thick lower siltstone layer and thin upper mudstone layer. The silt layer is multi-graded in parts, with very thin lighter silt layers interpreted to be underflow deposits. Small clasts are scattered throughout, and interpreted to be ice-rafted debris. The folding of laminae around the clasts is a differential compaction and drape effect. The bedding is interpreted to have a seasonal element, with silts deposited during the spring melt, and associated increased clastic input to the basin. The mudstone layer represents deposition of clay grade particles from suspension during the winter. This could also represent non-seasonal periodic fluctuations in clastic input to the basin, and it is notable that the layers are not of equal thickness. (6cm core)

A



B

PLATE 12

A. Eremophila 1 186.0m (Hoya Formation)

Type 1 bedded mudrocks (FL), each bed displaying a smooth gradation from light-grey siltstone to a dark-grey mudstone. There are hints of laminations within the silt unit, but these are not well developed. (6cm core)

This is interpreted to be a lacustrine mudstone, deposited from combined underflow,interflow and overflow currents, the overall grading resulting from periodic reduction in clastic supply to the basin, possibly seasonal.

B. Eremophila 1 178.40m (Hoya Formation)

Type 2 bedded mudrocks (Fl) each bed grading from light-grey siltstone to very dark grey mudstone. The siltstone layer is multi-layered, with numerous thin laminae of silt and occasional very fine-grained sandstone. The mudstone layer is thicker than type 1.

Similar to type 1, but with increased input from underflow current producing the multi-layered siltstone layer.

C. Eremophila 1 176.80m (Hoya Formation)

Type 3 bedded mudrocks (Fl) comprising thinly laminated light-coloured siltstones and very-fine sandstones, and darker mudstones. Many of the layers are internally graded and fine-upward into a mudstone. Lamination thickness is variable, but appears to be grouped into sets in places.

This suggests a highly variable input, dominated by underflows within a lacustrine setting. The gradation from Type 1 to Type 3 suggests the increasing proximity of the clastic source.

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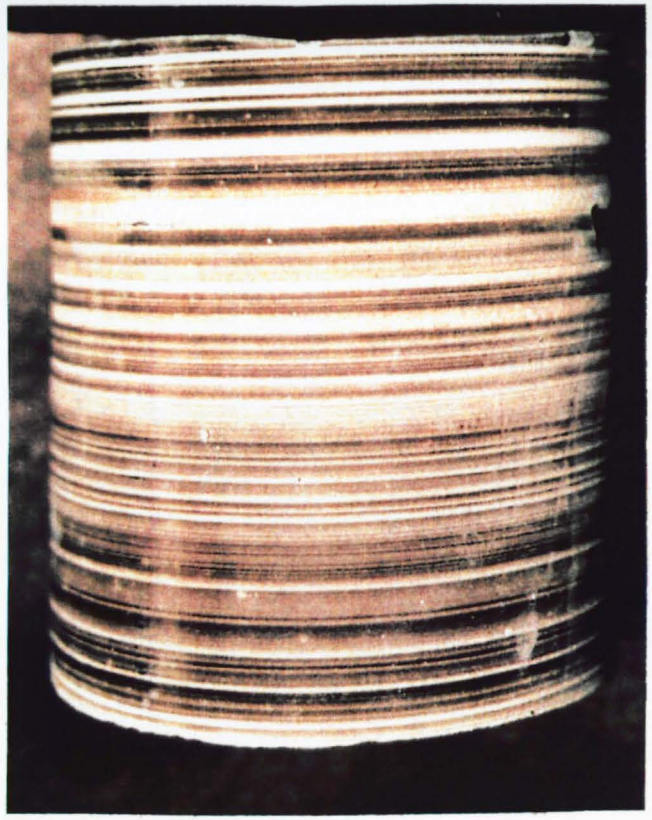


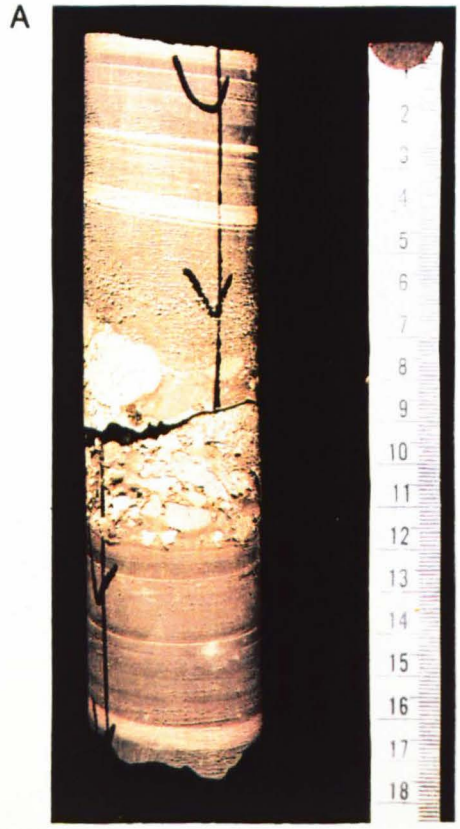
C

PLATE 13

A. Clianthus 1 423.57m (Hoya Formation)

A bedded mudrock (F1) comprising dark-grey mudstone and thin light grey-brown siltstone layers. Interbedded within this unit are a number of clasts of mixed lithologies (mainly basement material) randomly oriented and ill-sorted. The lower clasts appear to be embedded into the mudrock. Isolated clasts 'dropstones' are also recorded from this mudrock unit.

The mudrock is interpreted to be deposited within a low-energy basinal environment, with occasional input of silt-grade material from periodic underflows. The collection of clasts are interpreted to represent a 'dropstone cluster' deposited rapidly from a floating iceberg. During transport icebergs commonly concentrate debris on their upper surface due to melting (see Plate 17). Irregular melting of the submerged basal section during transport of the iceberg may result in an unstable configuration **(B)** and subsequent 'roll over' into a more stable orientation **(C)**. This process allows for the rapid deposition of clasts to form a 'cluster' **(C & D)**.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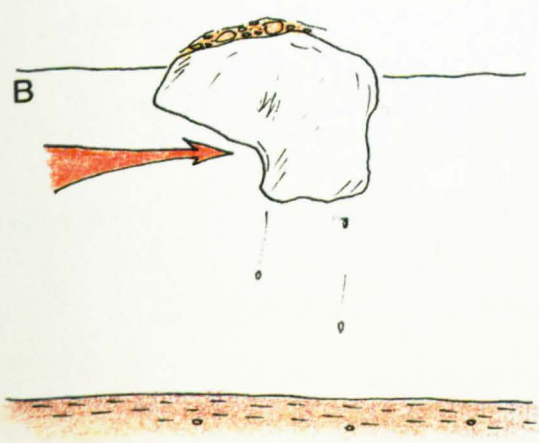
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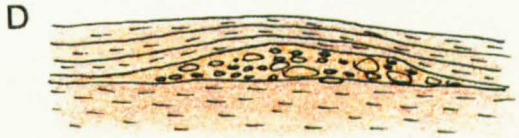
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PLATE 14

A. Drosera 1 430m (Hoya Formation)

Close up of a conglomerate from Sandstone Facies 1, comprised of subrounded to subangular basement clasts and more locally derived dolomitic limestone clasts. (4.5cm core)

B. Drosera 1 420.81m (Hoya Formation)

The upper contact between a petromict conglomerate, possibly exhibiting low-angle plane-bed lamination (see core break), overlain abruptly by a medium-grained, flat-bedded sandstone.

C. Kunzea 1 192.95m (Hoya Formation)

Low-angle plane-bedded and cross-bedded medium to coarse-grained sandstones. Fining-upward is clearly observed within each bed.

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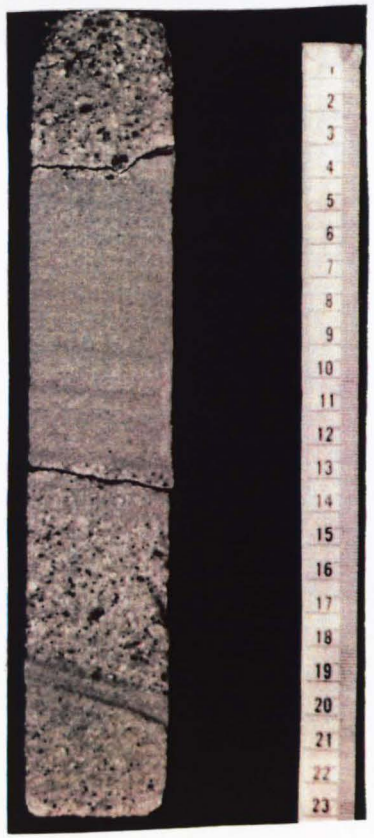
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PLATE 15

A. Ficus 361.30m (Hoya Formation)

The sharp basal contact of a fining-upward sandstone, sandstone facies 5, with abundant mudstone rip-up clasts. (4cm core)

B. Hoya 1 279m (Hoya Formation)

Intraclast conglomerate, comprising abundant mudstone and siltstone clasts in a fine to medium-grained sandstone matrix. The clasts display a bed parallel lineation. (4cm core)

C. Hoya 320.05m (Hoya Formation)

Intraclast conglomerate, with large mudstone clasts, which commonly appear to be slightly deformed suggesting only partial lithification prior to transport. (4cm core)

D. Drosera 1 311.80m (Hoya Formation)

Intraclast conglomerate, containing large clasts of massive and laminated mudstones. The large clast of laminated mudstone contains small dropstones, indicating it was derived from a glacial environment. (6cm core)

All these conglomerates are interpreted to contain rip-up clasts, and were probably deposited within channels.

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PLATE 17

Examples of present day glacial environments which bear some similarity to the depositional models proposed for the Hoya Formation.

A. Iceberg with concentration of debris on upper surface. This is evidence for the transport of clasts by ice, and can be viewed in conjunction with Plate 13. (Portage Lake, Alaska)

B. Fan complex fed by a glacier building out into a marine/lacustrine setting. This could also form entirely subaqueously. Note the plumes of suspended sediment and abundance of floating ice. (Glacier Bay, Alaska)

C. Braided fluvial outwash fed by a glacier/ice sheet, and controlled by topographic constraints. An analogue perhaps for the Drosera type fluvial sandstones. (Unknown location, source Bristol University Library)

A

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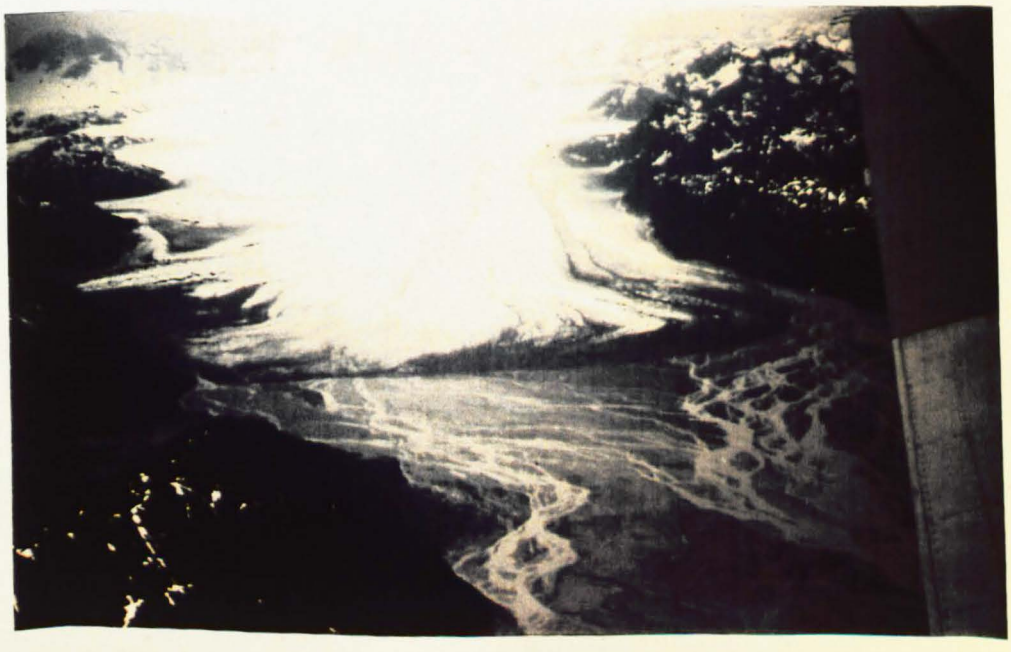


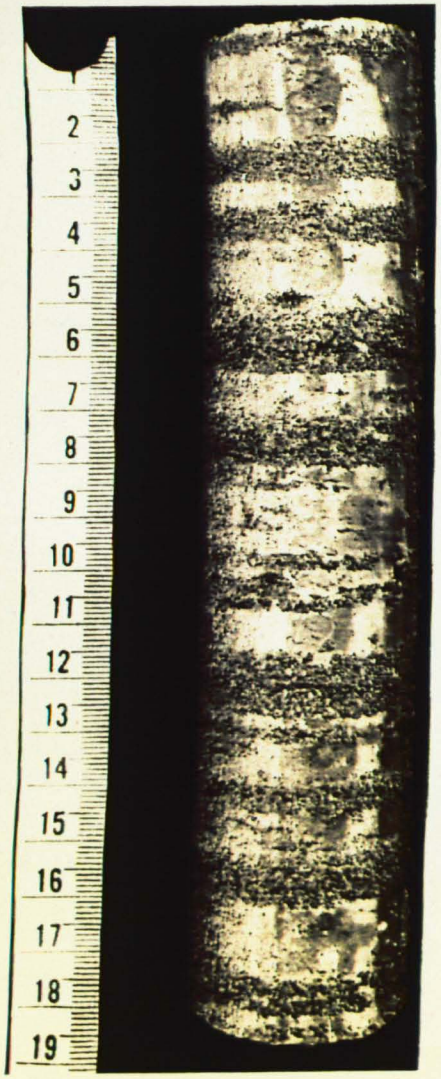
PLATE 18

A. Calytrix 1 218.61m (Calytrix Formation)
Sandstone facies Thinly bedded medium to fine-grained sandstone, coarser layers picked out by the mud filter-cake, due to their increased permeability. (4cm core)

B. Calytrix 1 (Calytrix Formation)
Sandstone facies Interbedded coarse sandstone containing large pebble size clasts and scattered shelly material (large bivalve shell towards the top of the core) and interbedded fine-grained argillaceous sandstone, with a mottled bioturbated appearance. Interpreted to be storm sands. (6cm core)

C. Calytrix 1 199.05m (Calytrix Formation)
Calcareous mudstone facies. Medium grey calcareous mudstone containing abundant delicately preserved bryozoa, and less common bivalves. Deposited in a low-energy marine basinal setting. (6cm core)

D. Calytrix 1 182.50m (Calytrix Formation)
Mudrock facies. Thinly bedded mudstones and silty mudstones. Fining-upward units from silty mudstone to mudstone, with abundant small lozenge shaped burrows (possibly Chondrites) in the lower silty horizons. Deposited under marine low-energy basinal conditions, with a periodic control on clastic input producing the grading. (6cm core)



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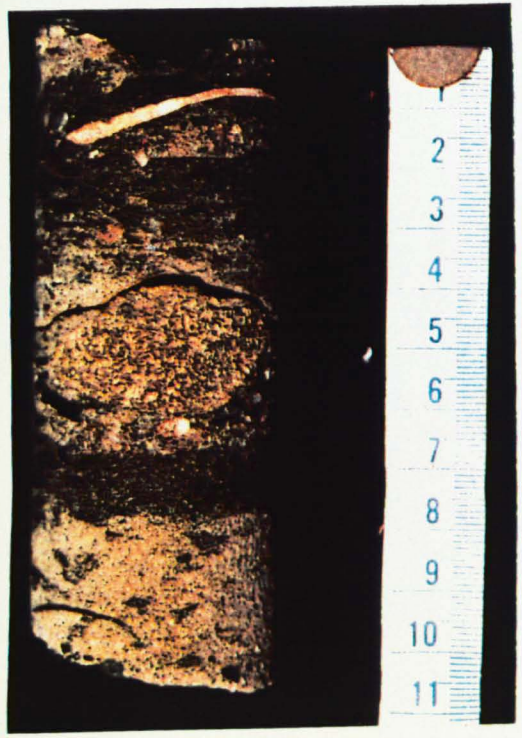

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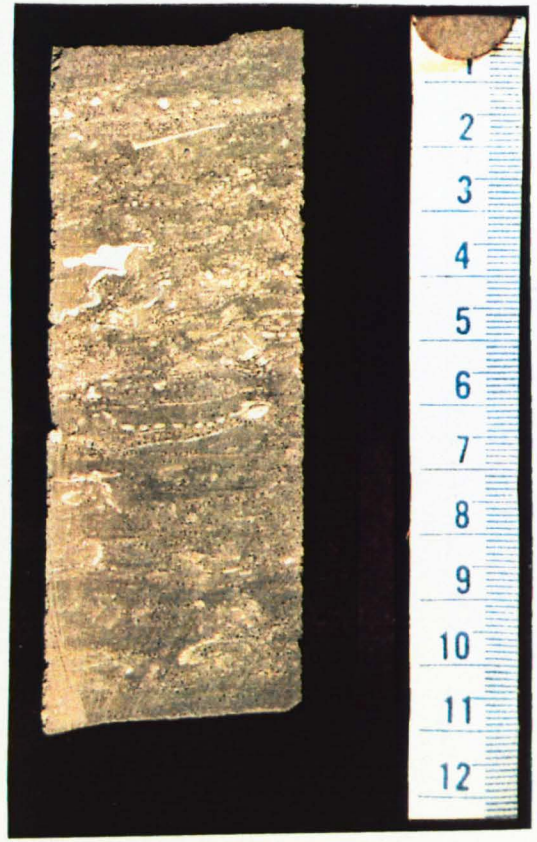

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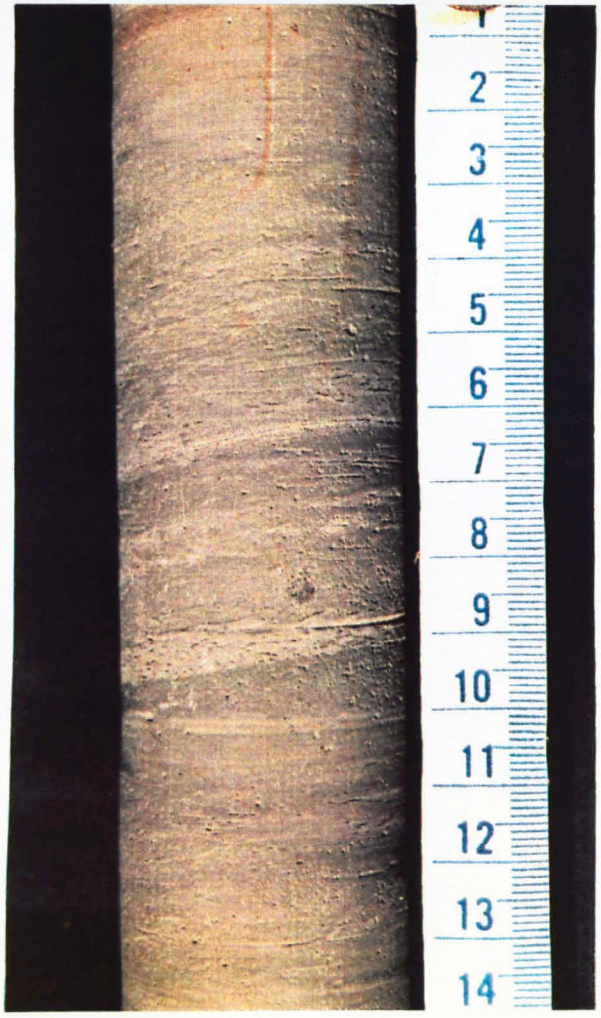


D

PLATE 19

A. Calytrix 1 141.40m (Clianthus Formation)

The top of an upward-fining sandstone, with thin carbonaceous laminations or 'hash'. The sandstone is abruptly overlain by a medium-grained sandstone containing large coaly clasts as lag. Interpreted to be deposited within a sandy bedload-dominant fluvial system. The upward-fining sequence indicates waning flow, with fine carbonaceous material finally coming out of suspension as draping lamination, possibly as a bar-top deposit. (6cm core)

B. Calytrix 1 136.59m (Clianthus Formation)

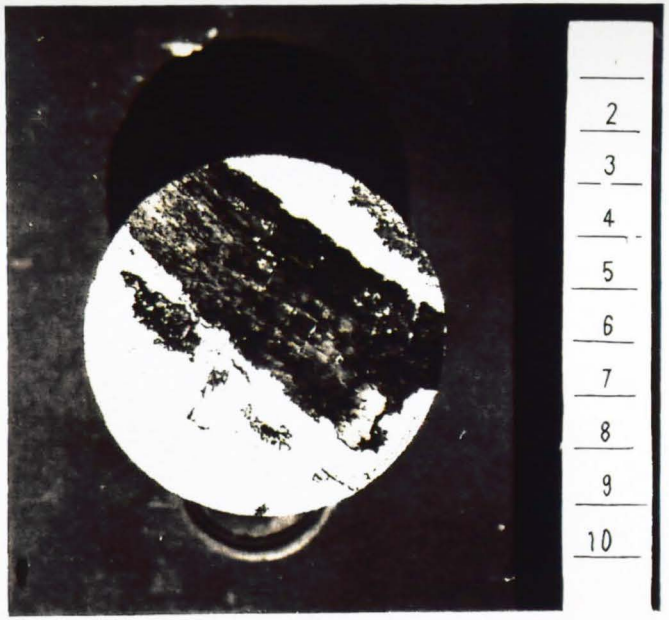
An example of a large fragment of coaly material, indicating the abundance of vegetated areas in the source area (6cm core).

C. Calytrix 1 136.59m (Clianthus Formation)

Similar to above, large coaly debris as lags within the medium -grained sandstone. (6cm core)

A

B



C

PLATE 20

A. Calytrix 1 108.28m (Clianthus Formation)

Heterolithic sandstone, siltstone and mudstone. The fine to very fine-grained sandstones contain abundant wave and current ripples. Also ptygmatically folded syneresis cracks, or possibly water escape features. (6cm)

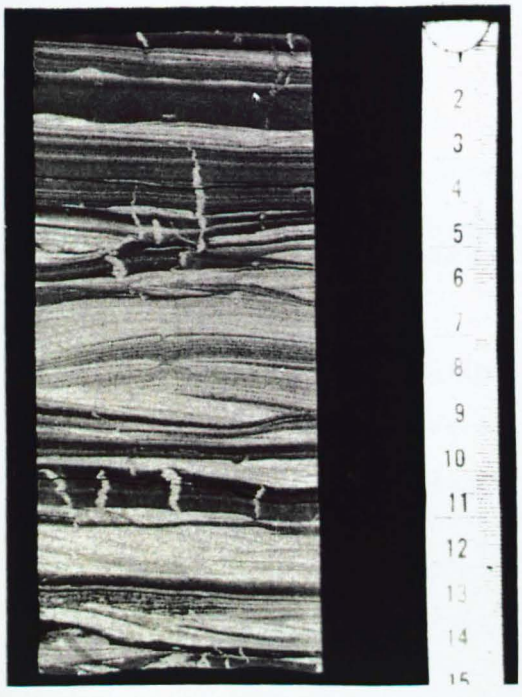
B. View of the bedding plane, clearly displaying the linear injection features, possibly syneresis cracks or water escape features. (6cm)

C. Calytrix 1 92.37m (Clianthus Formation)

Laminated fine to very fine-grained sandstone and interbedded thin silty mudstones. Bioturbation is evident although not pervasive. Isolated zones display soft-sediment deformation, slumped and contorted bedding. The sandstones display low-angle bedding, perhaps representing hummocky cross-stratification. (6cm core)

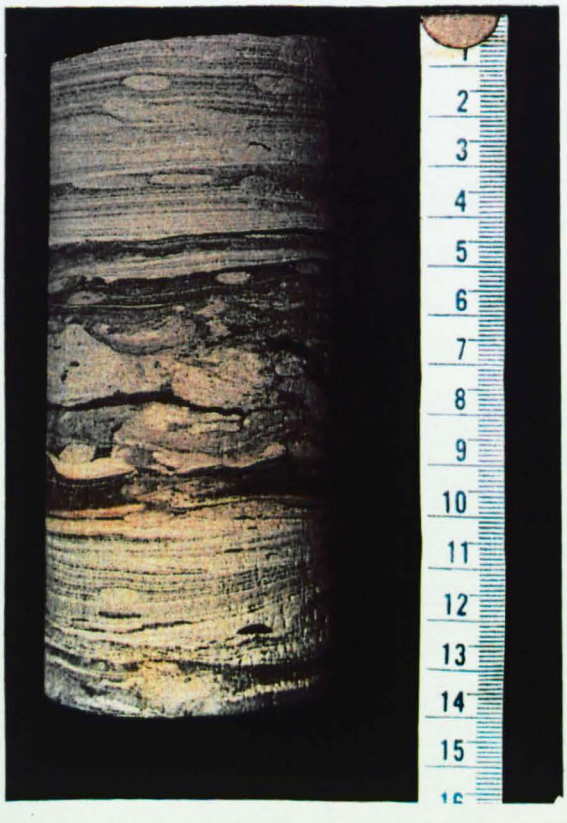
D. Ficus 1 176.50m (Clianthus Formation)

Interbedded fine to very fine-grained laminated sandstones and mudstones. The sandstones are parallel laminated, occasionally rippled, with minor amounts of bioturbation. (6cm core)



A

B



C

D

PLATE 21

A. Eremophila 1 165.60m (Clianthus Formation)

A reactivation surface at the top of a bioturbated silty mudstone, overlain by laminated silty sandstones. This suggest periods of erosion on the shelf, reflecting periodic storm events. Note the trace fossil assemblages in this facies are larger than those in the silty sandstone, again reflecting a change in the energy of the environment of deposition.(6cm core)

B. Eremophila 1 169.55m (Clianthus Formation)

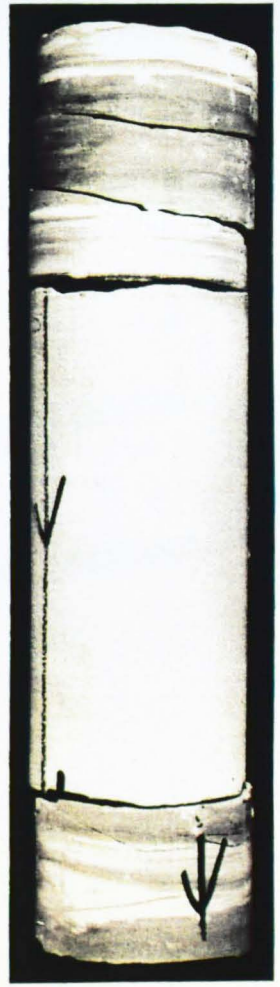
Example of small lozenge shaped burrows within a mudstone, possibly Chondrites. (6cm core)

C. Ficus 1 159.20m (Clianthus Formation)

A sharp based fine to very fine-grained sandstone within within a mudstone sequence. The sandstone is predominantly massive, the top 3cm fining upward to display fine laminations, before it is overlain by a medium grey mudstone. This is interpreted to be a rapidly deposited storm-induced mass flow. Thin sandstones in the underling mudstones display ripple lamination, indicating periodic current activity. (6cm core)

A

B



C

PLATE 22

A. Melaleuca 1 133.76m (Clianthus Formation)

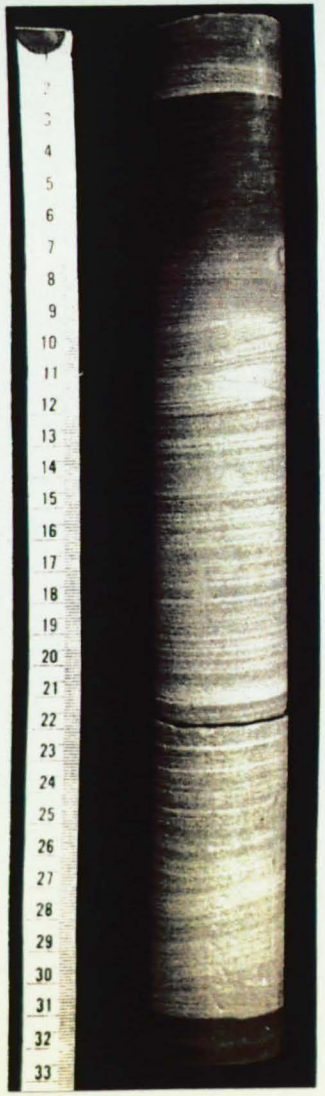
Large fining-upward unit, grading from a light grey, fine-grained sandstone to a dark-grey mudstone. The sandstone is sharp based and displays low angle cross-stratification, ripple lamination and fine parallel-lamination towards the top. The grading signifies a waning flow and cross stratification indicates current activity, suggesting emplacement by mass-flow processes. (4cm core)

B. Calytrix 1 86.95m (Clianthus Formation)

Laminated fine to very fine-grained sandstone displaying low angle cross-bedding, either trough sets or possibly hummocky cross stratification. (6cm core)

C. Ficus 1 108.0m (Clianthus Formation)

Cross-laminated sandstone with thin mudstone drape. (6cm core)



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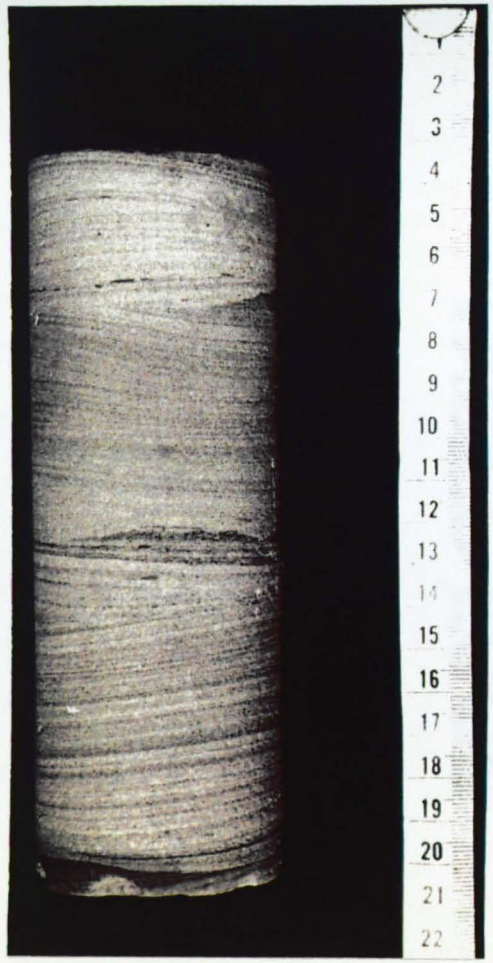

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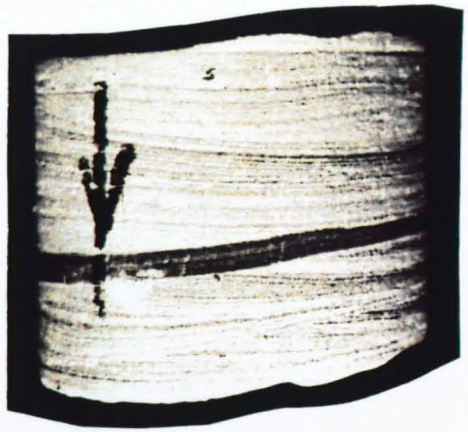
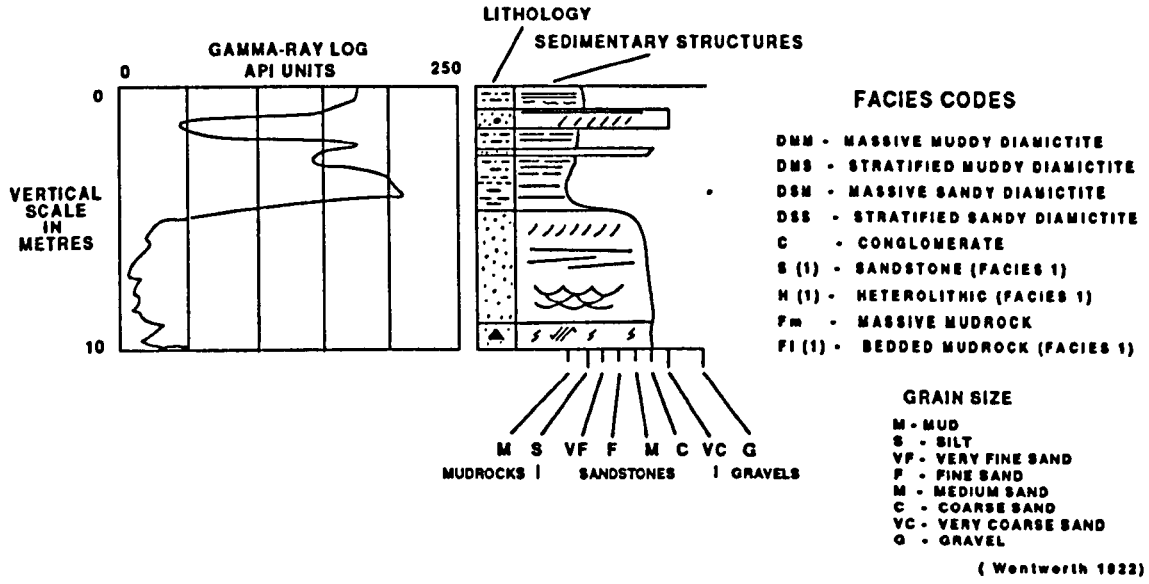


C

APPENDIX 1

FACIES LOGS



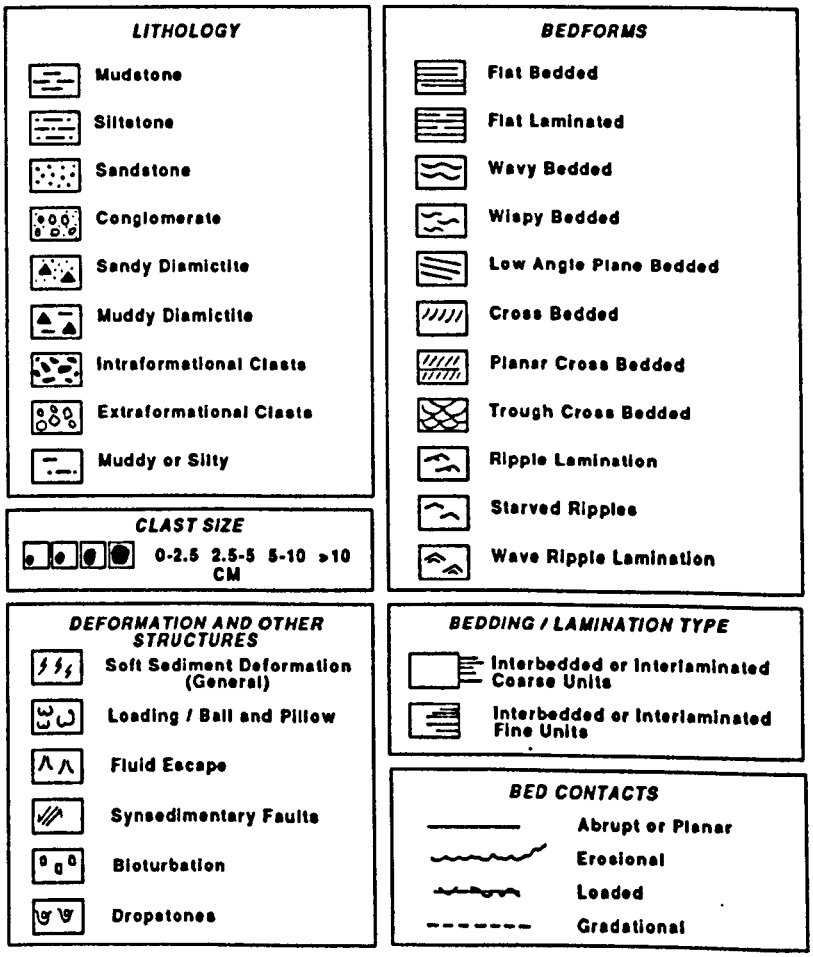


Figure 51. Key to facies log annotation

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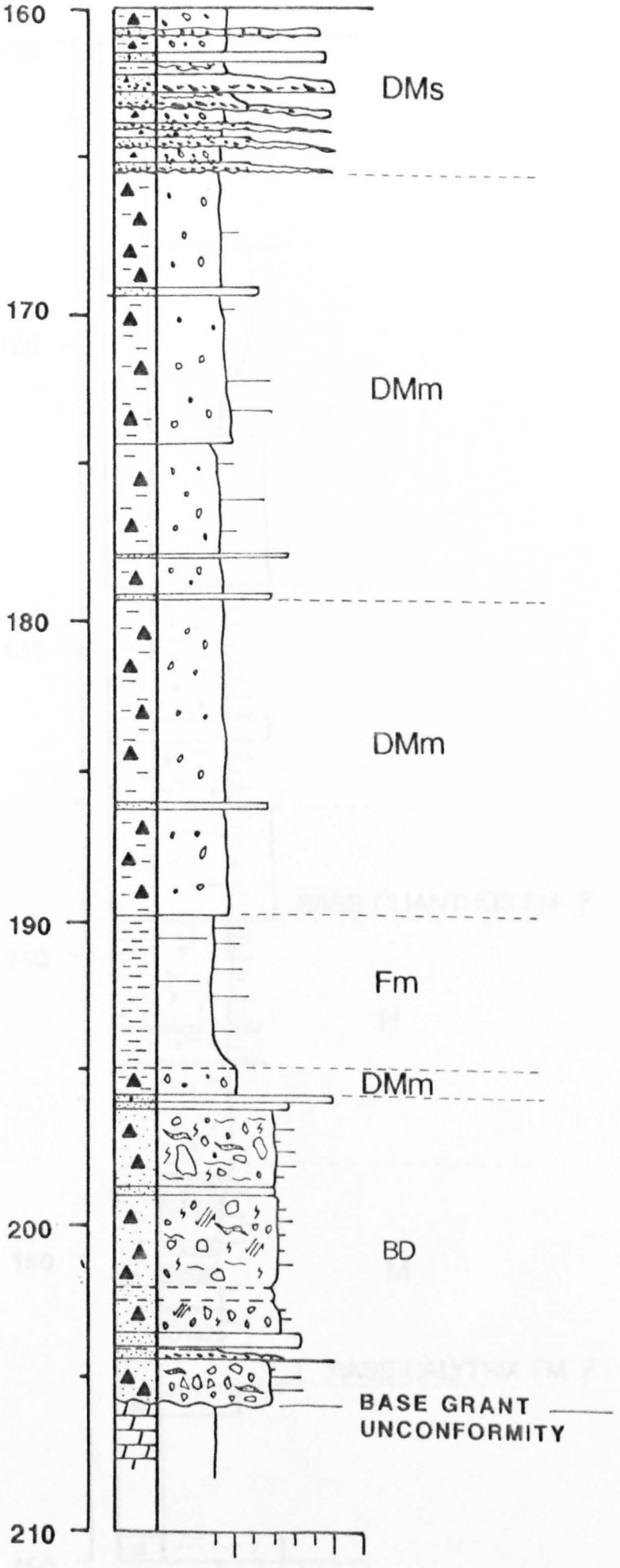
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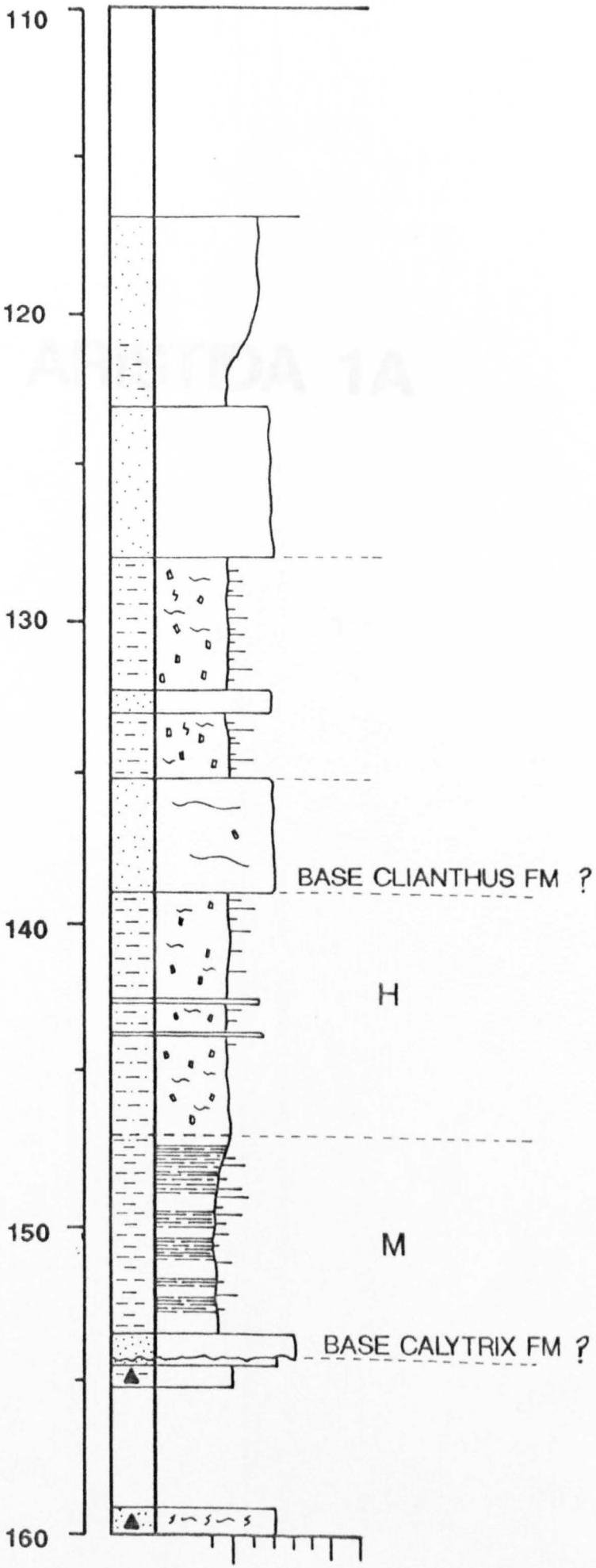
DMm
DMm
Fm
DMm
BD
BASE GRANT
UNCONFORMITY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H
M
BASE CALYTRIX FM ?

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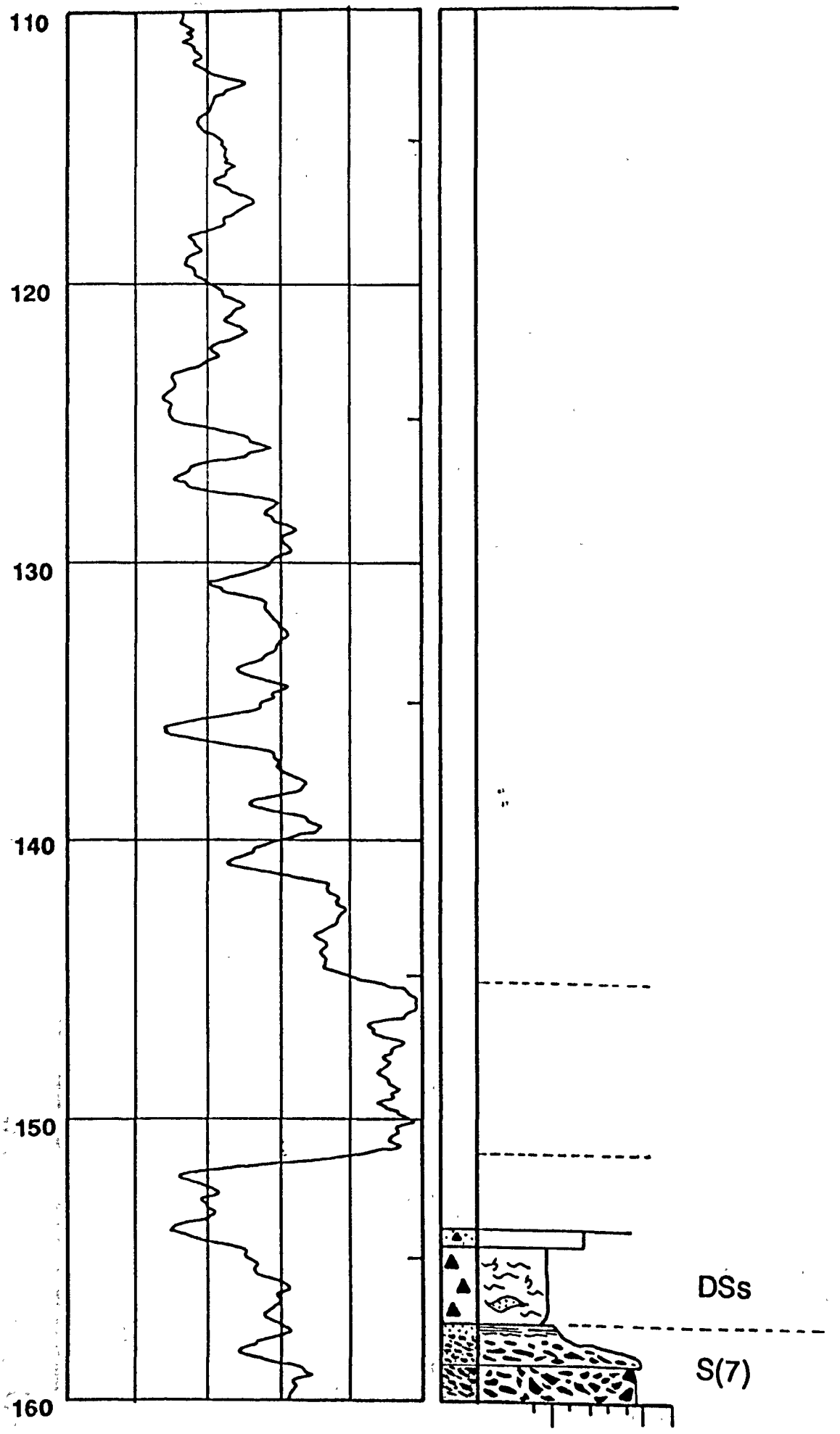
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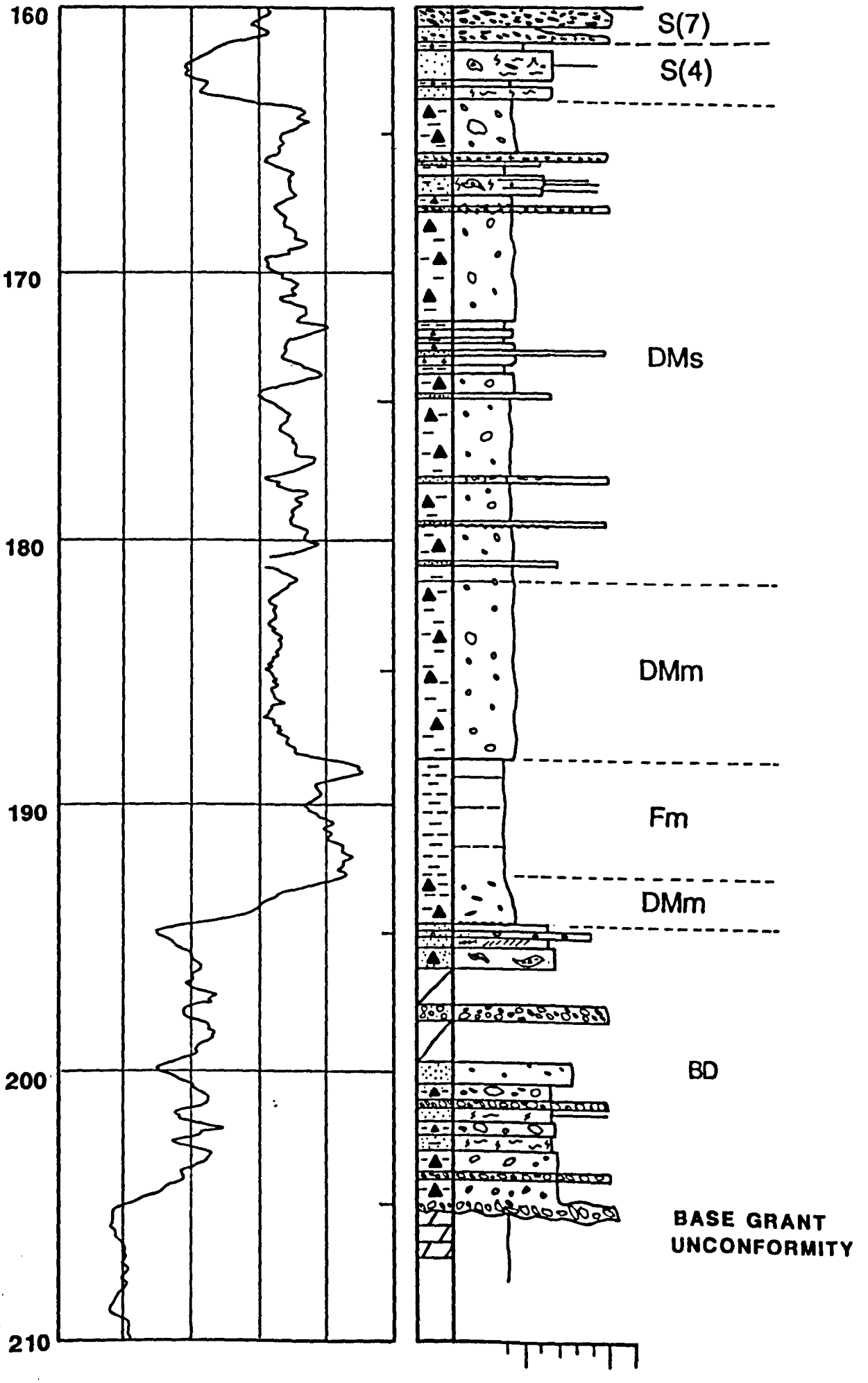
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S(7)
S(4)
DMs
DMm
Fm
DMm
BD
BASE GRANT
UNCONFORMITY

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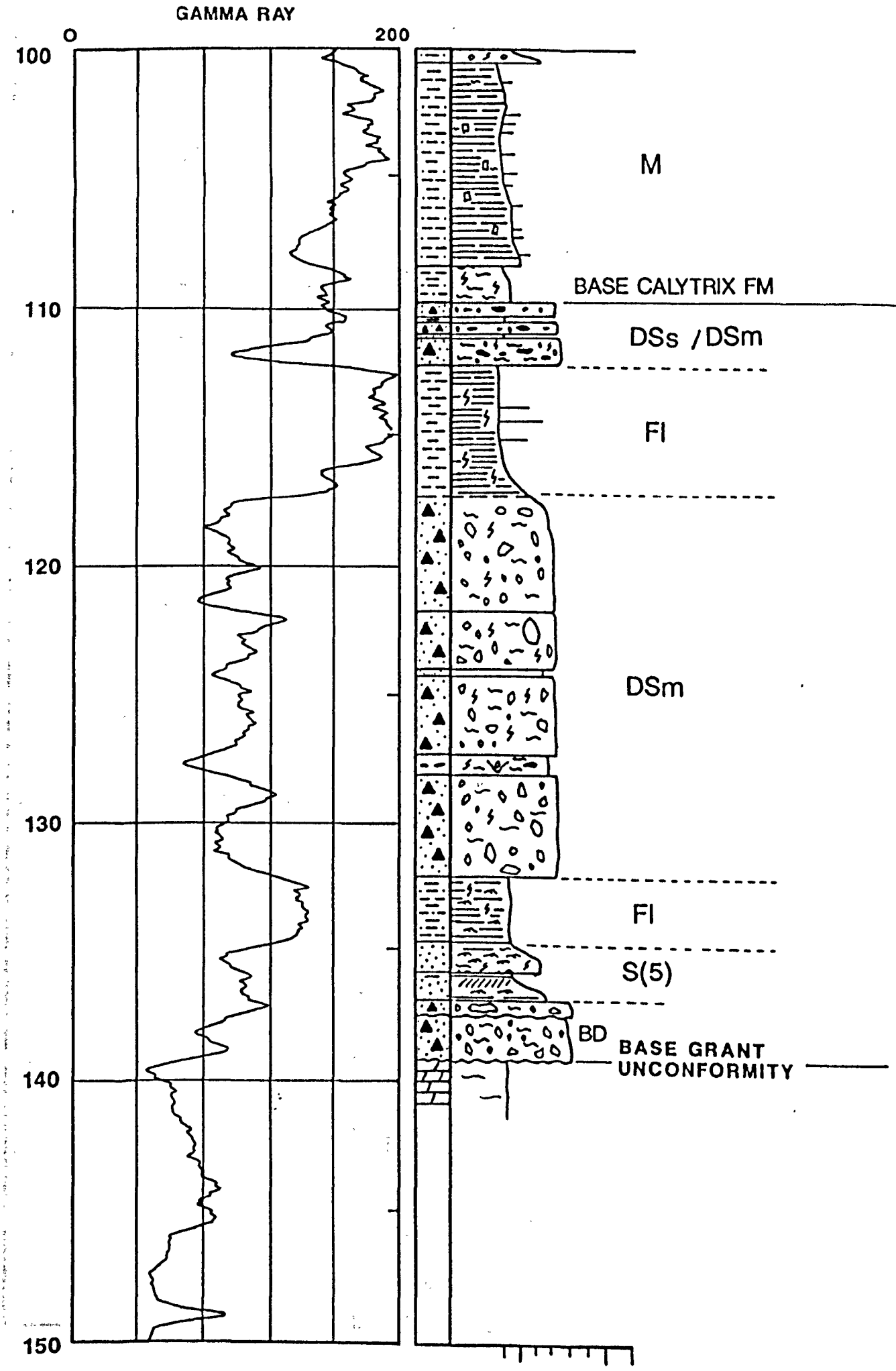
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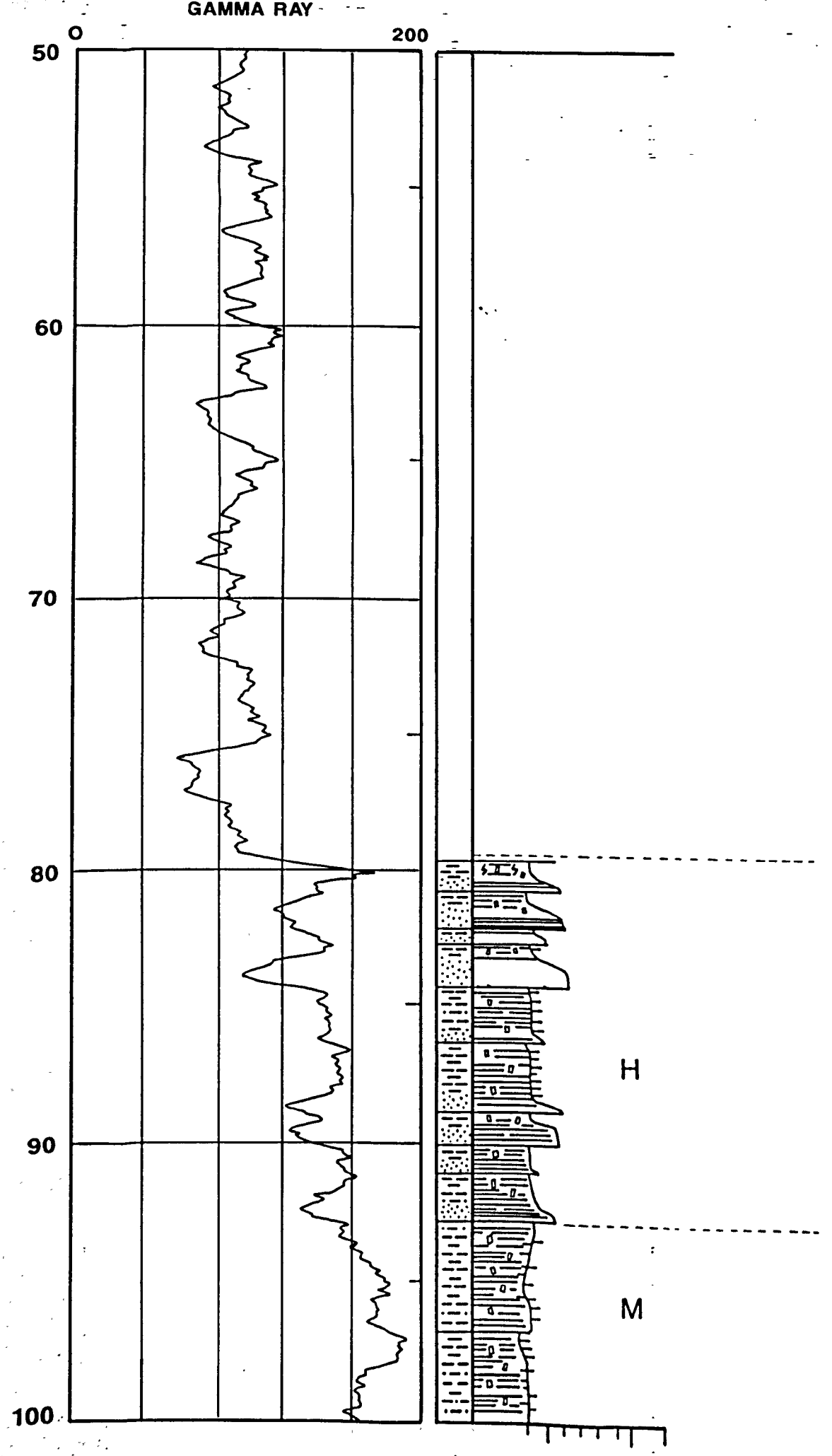
150
M
BASE CALYTRIX FM
DSs /DSm
Fl
DSm
Fl
S(5)
BD
BASE GRANT
UNCONFORMITY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H
M

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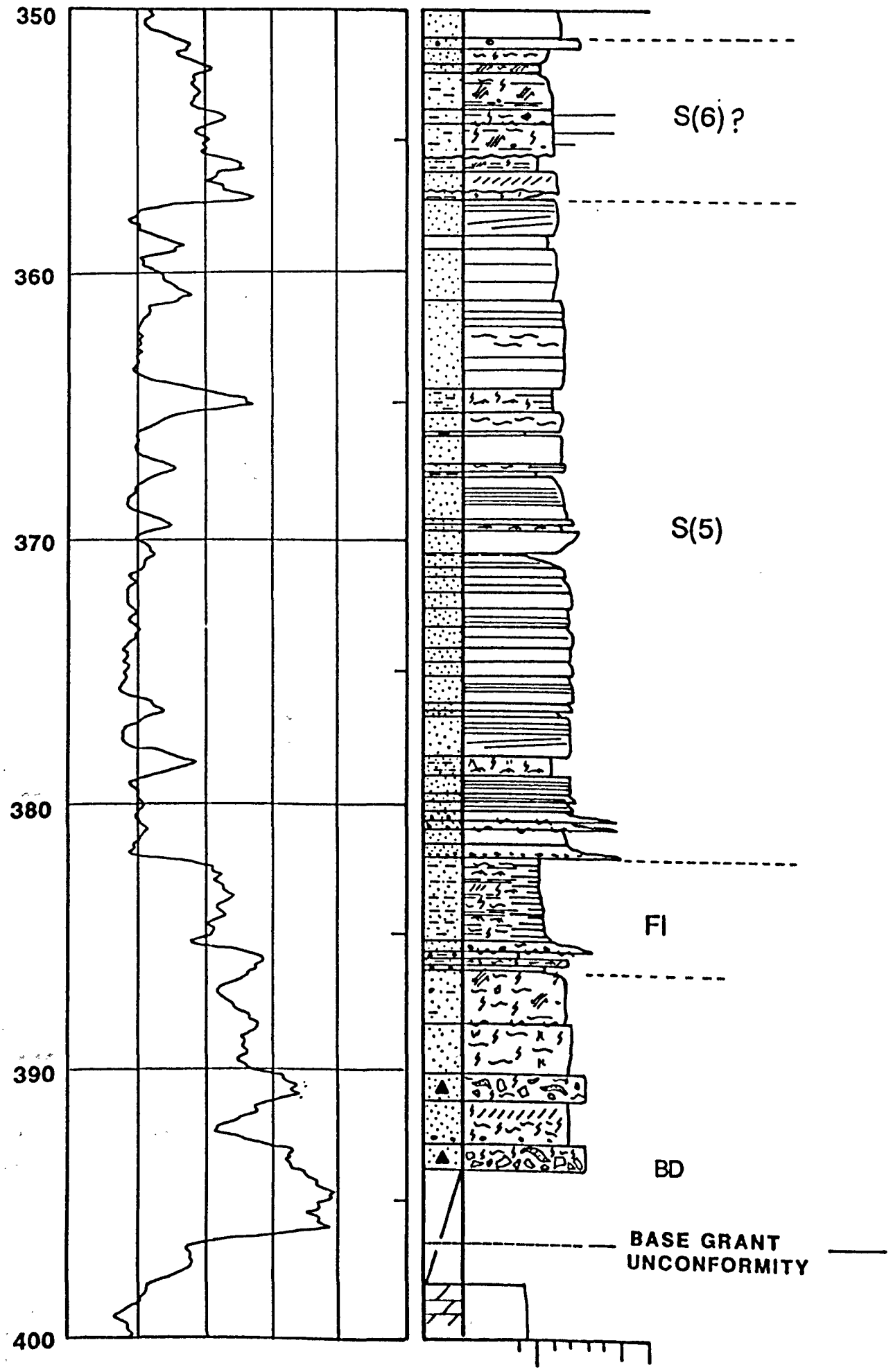
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S(5)
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BD
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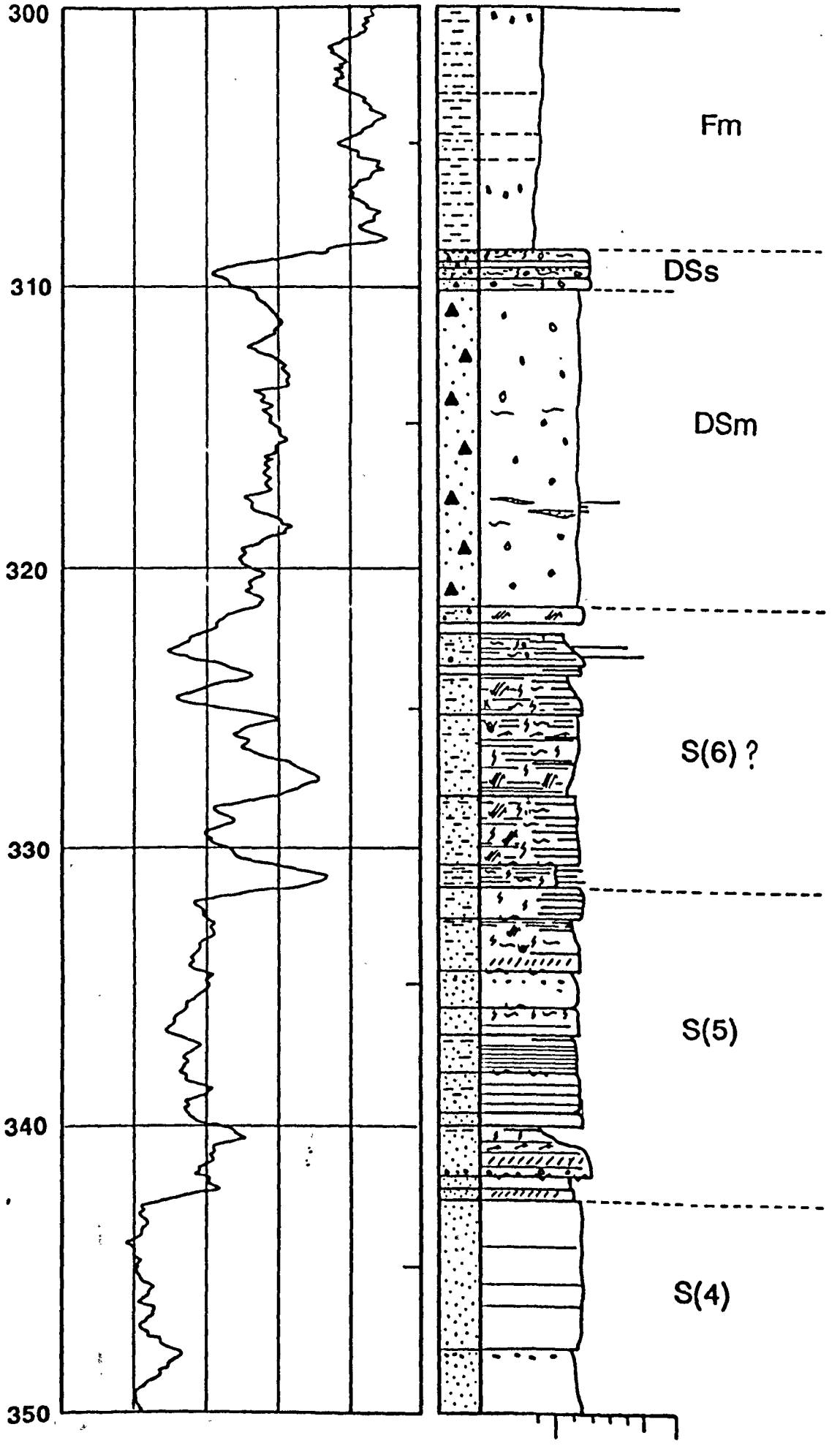
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DSs
DSm
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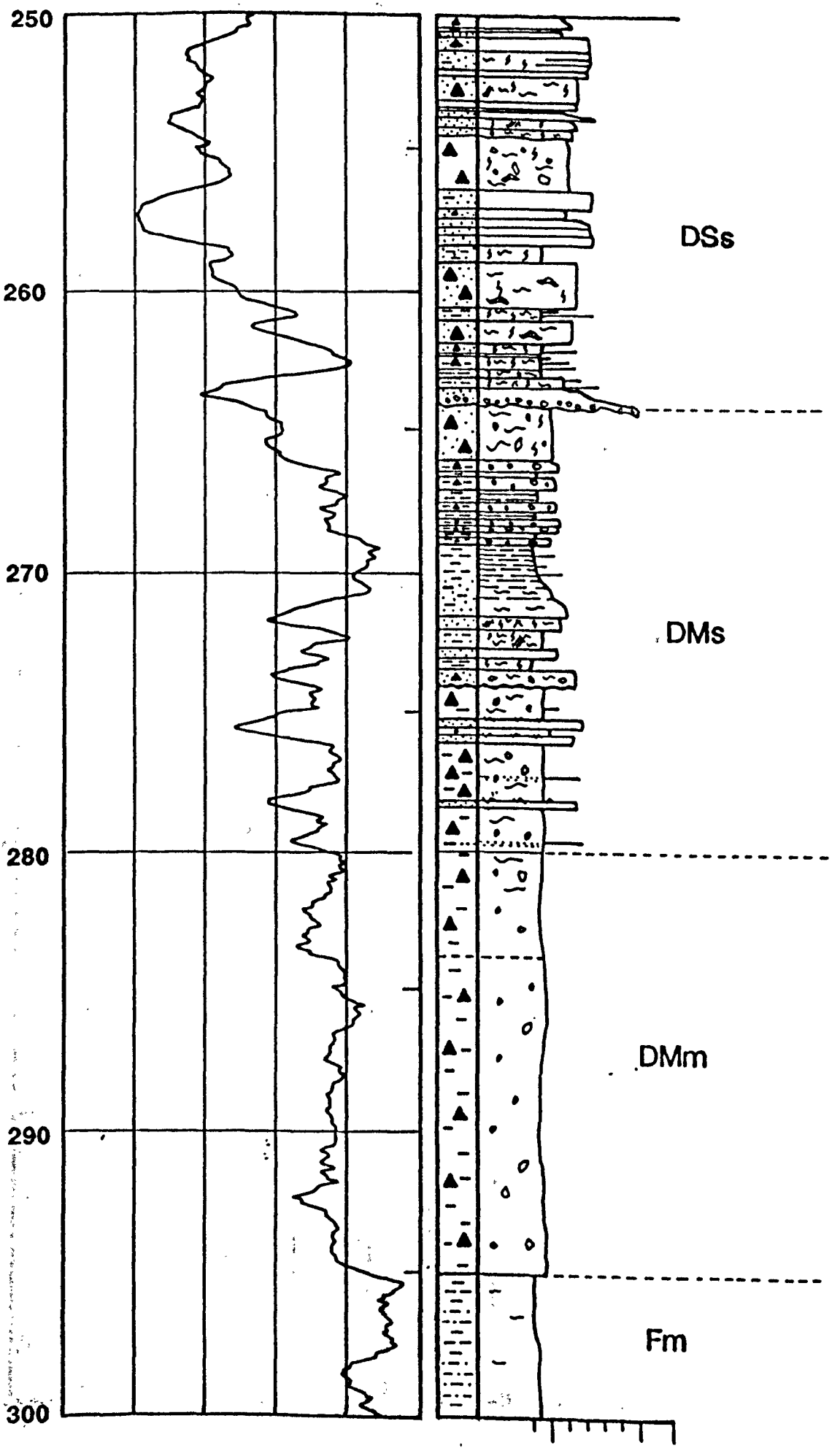
S(5)
S(4)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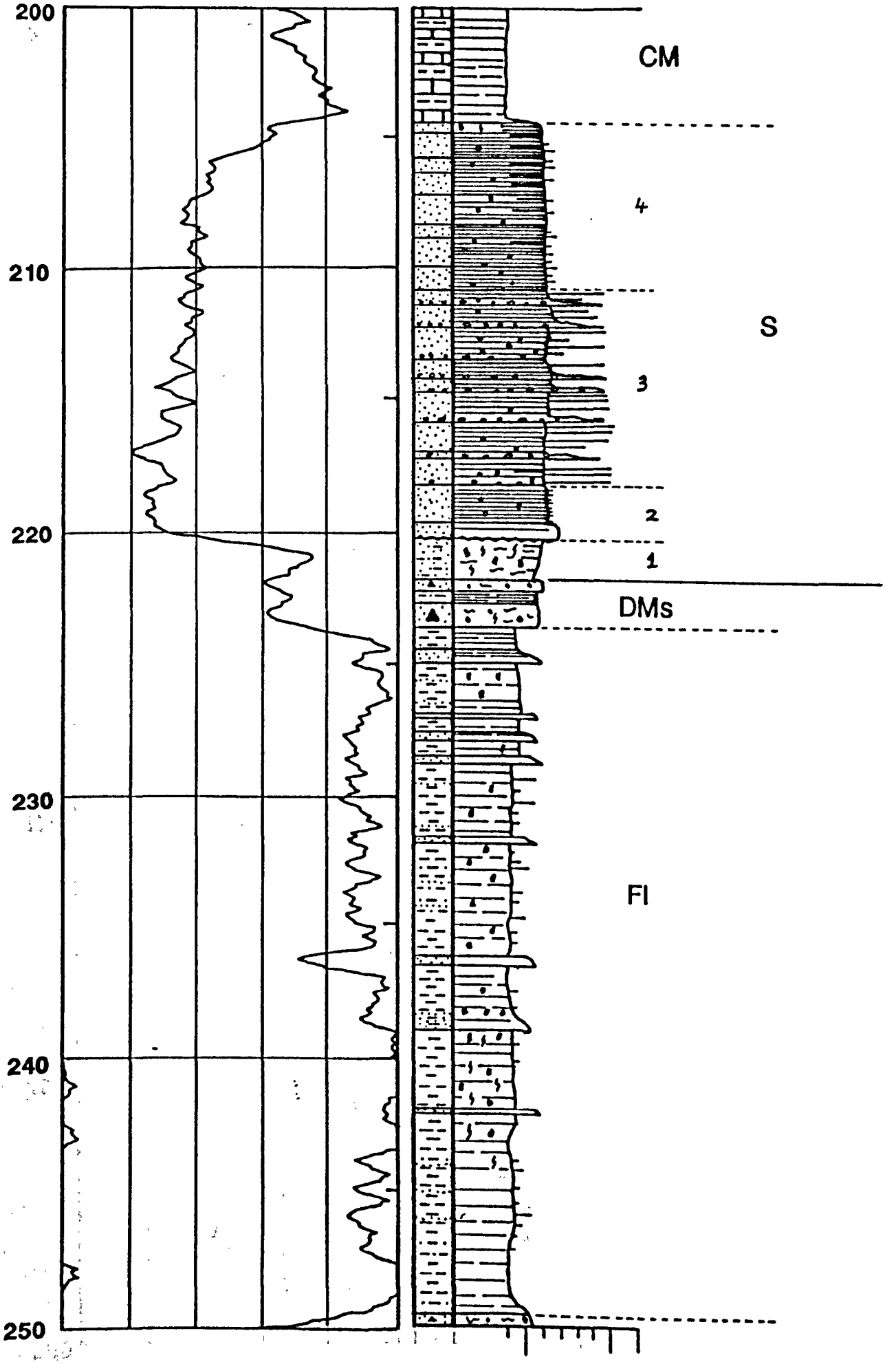
DMm
Fm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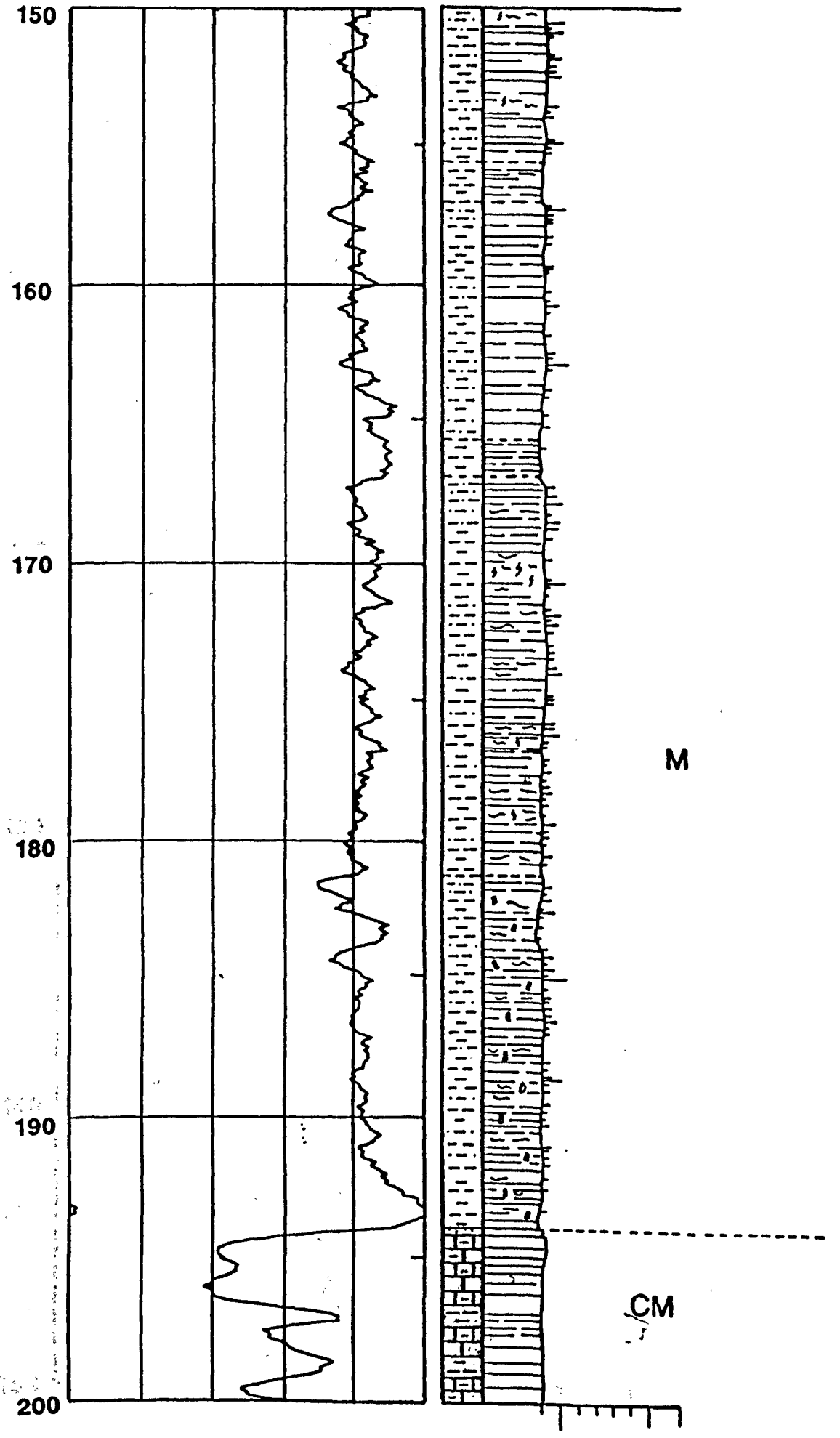
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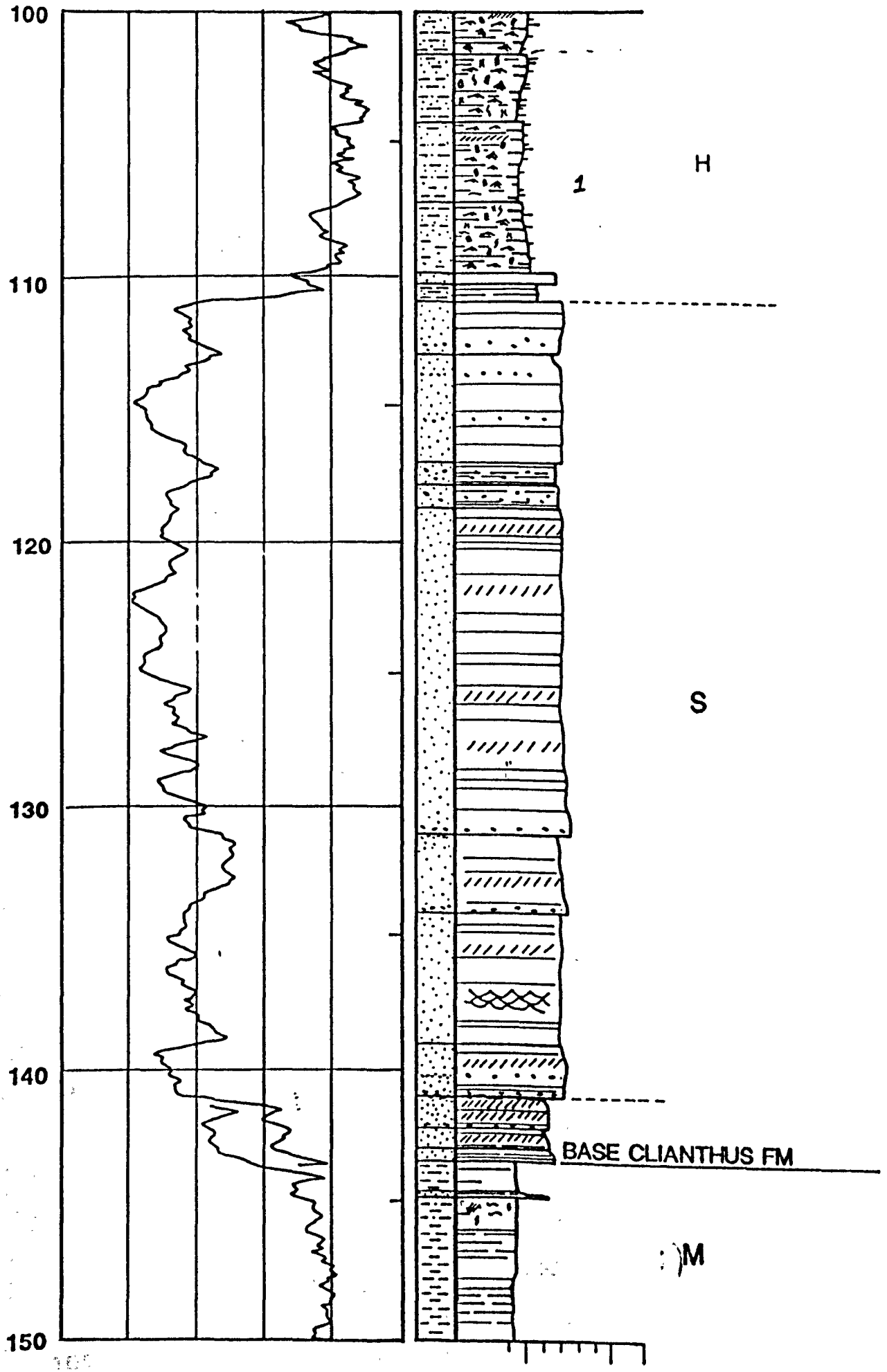
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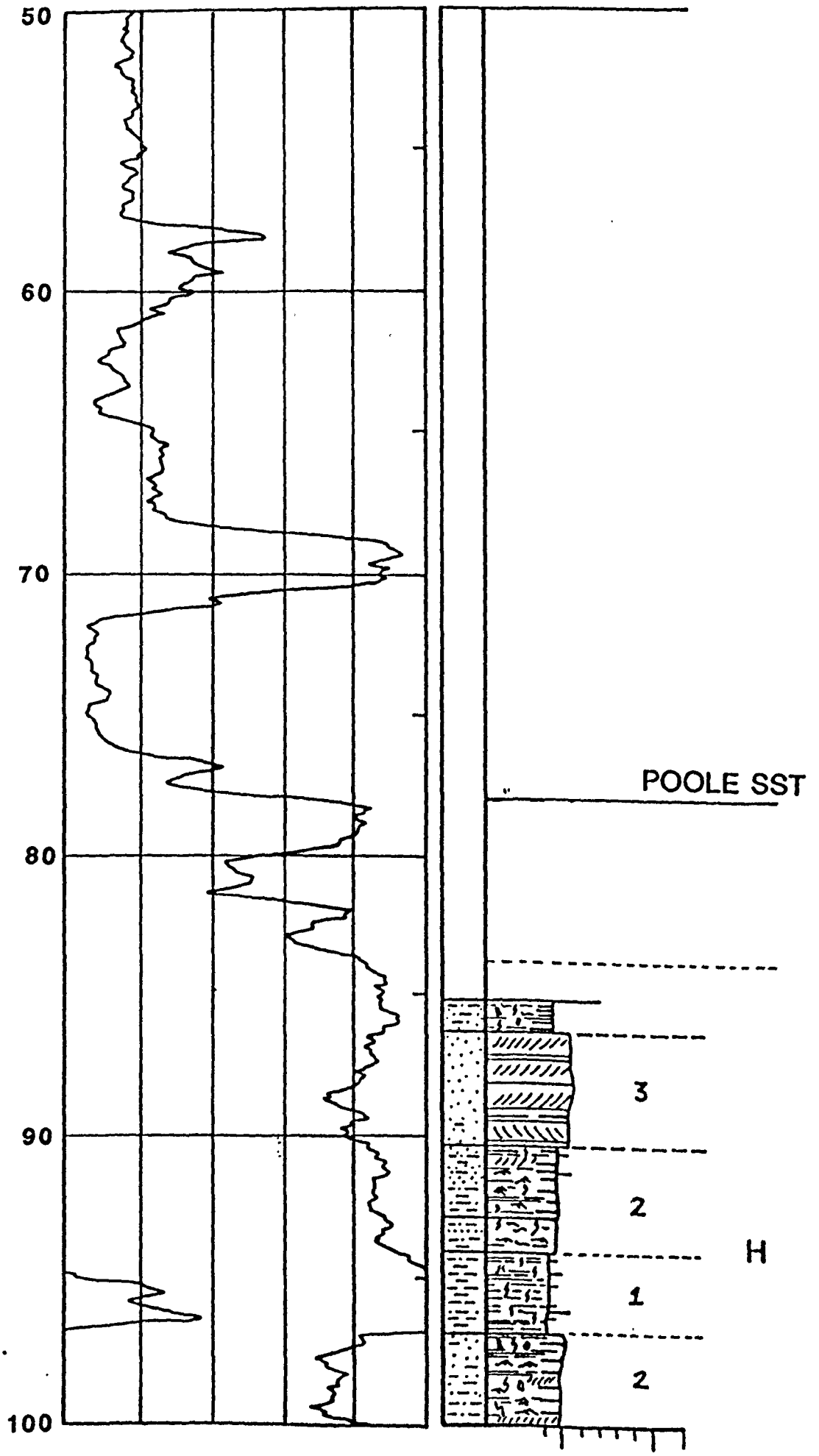
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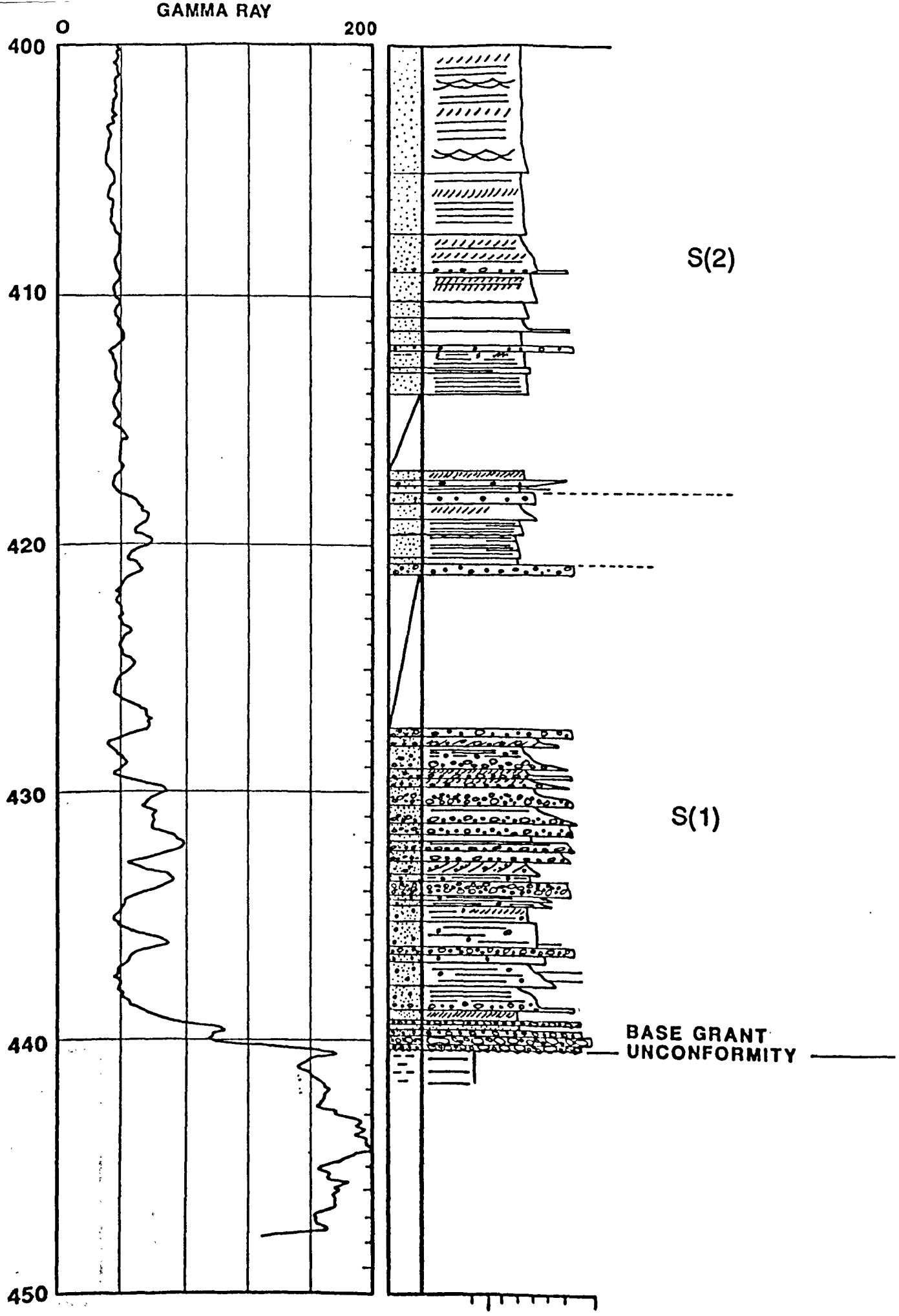
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S(1)
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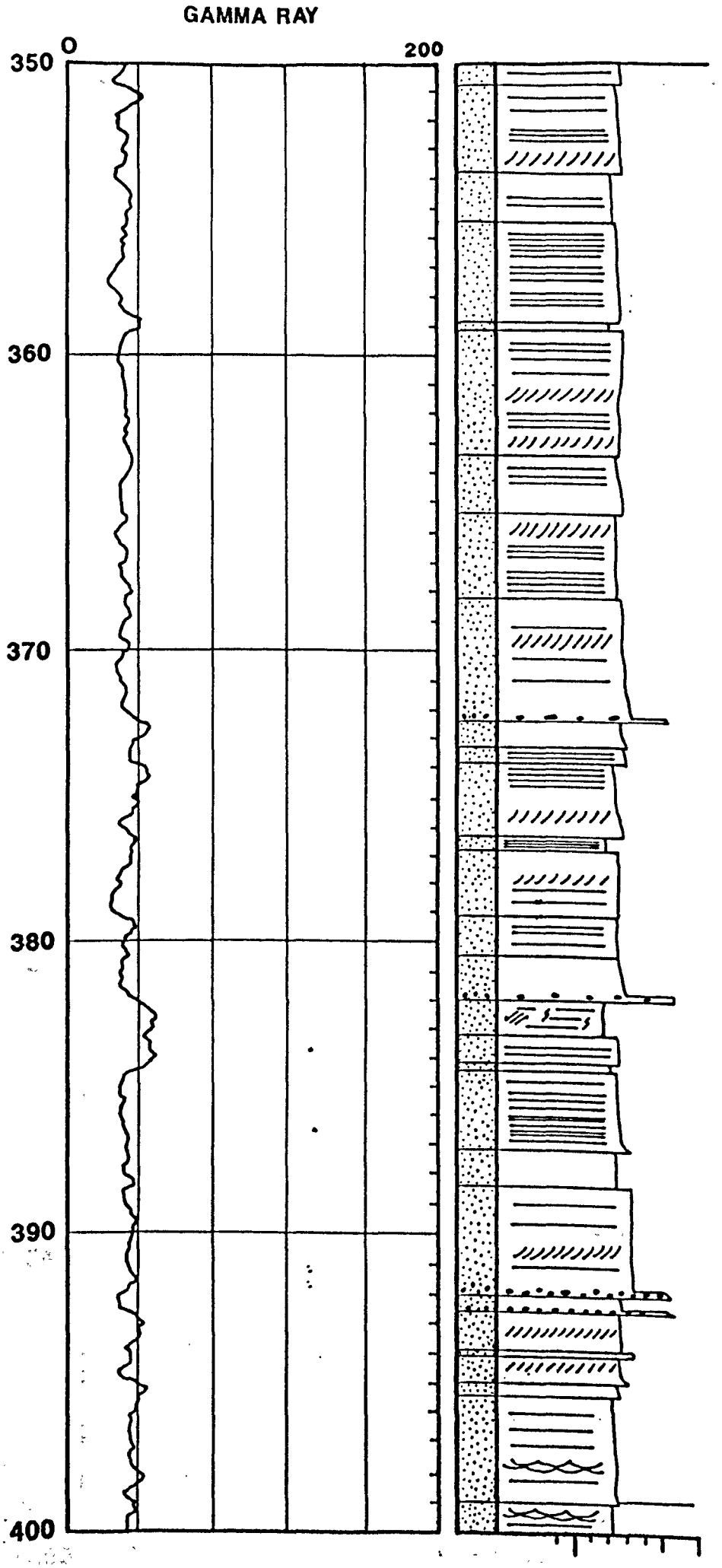

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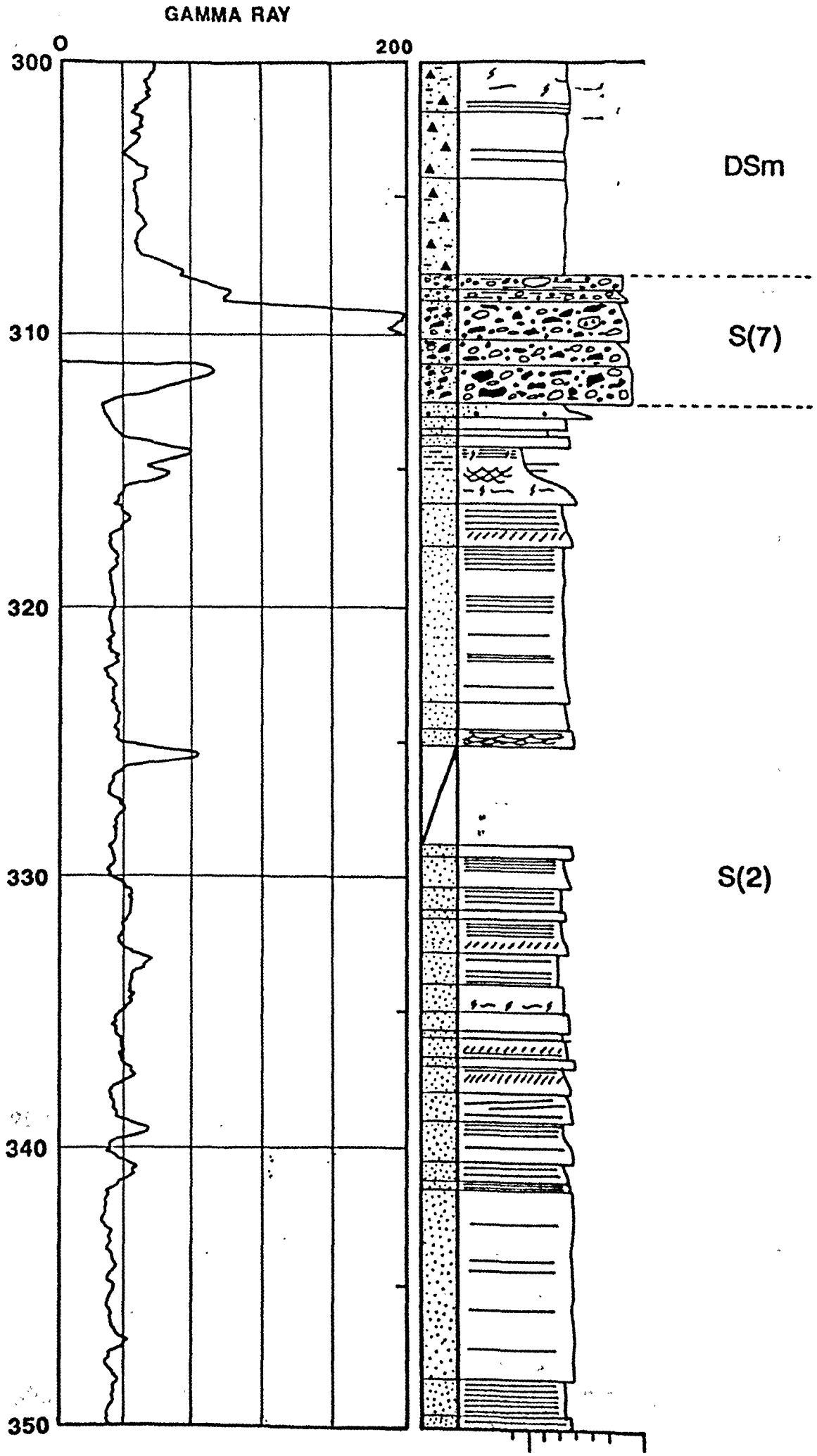
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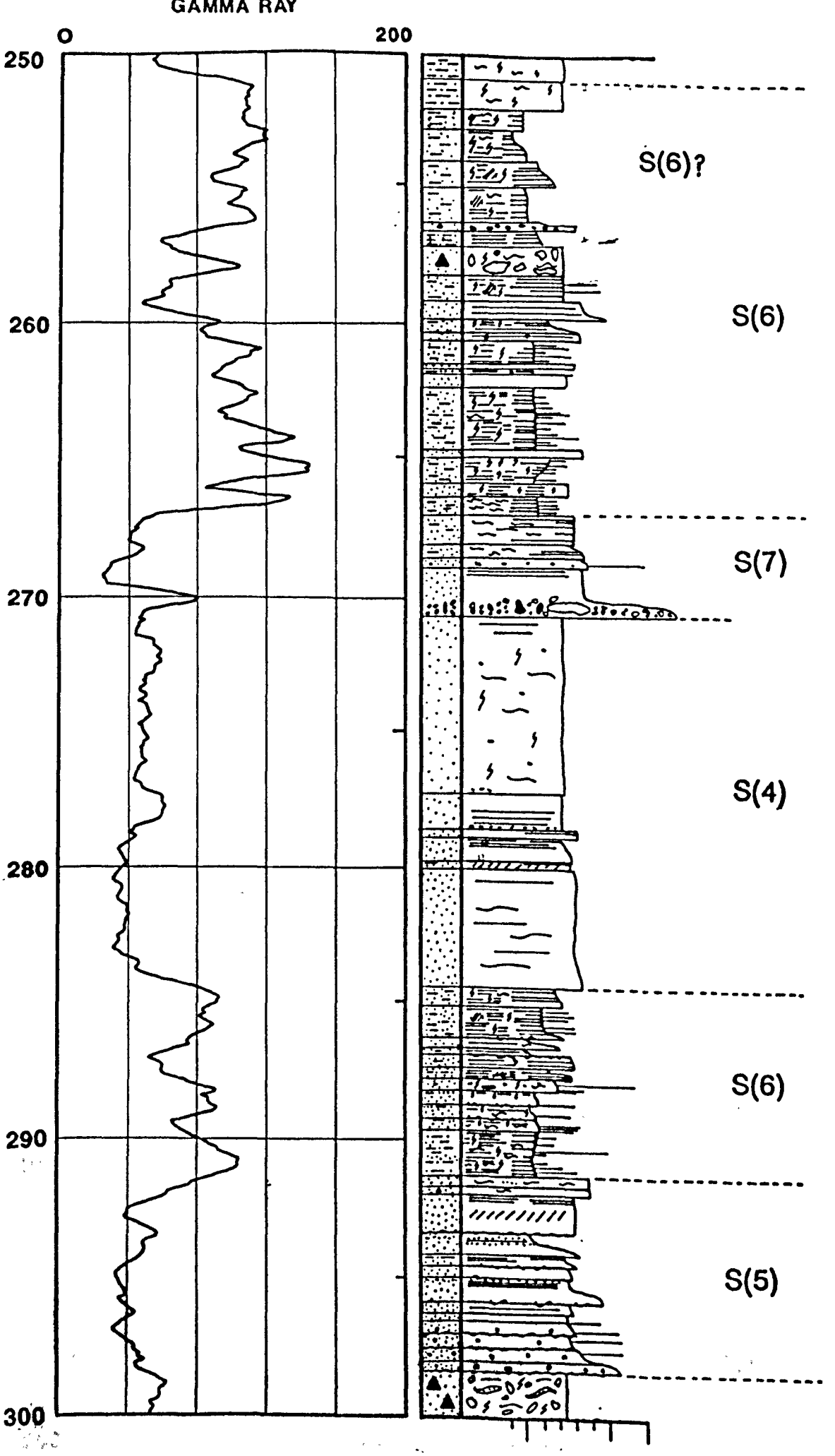
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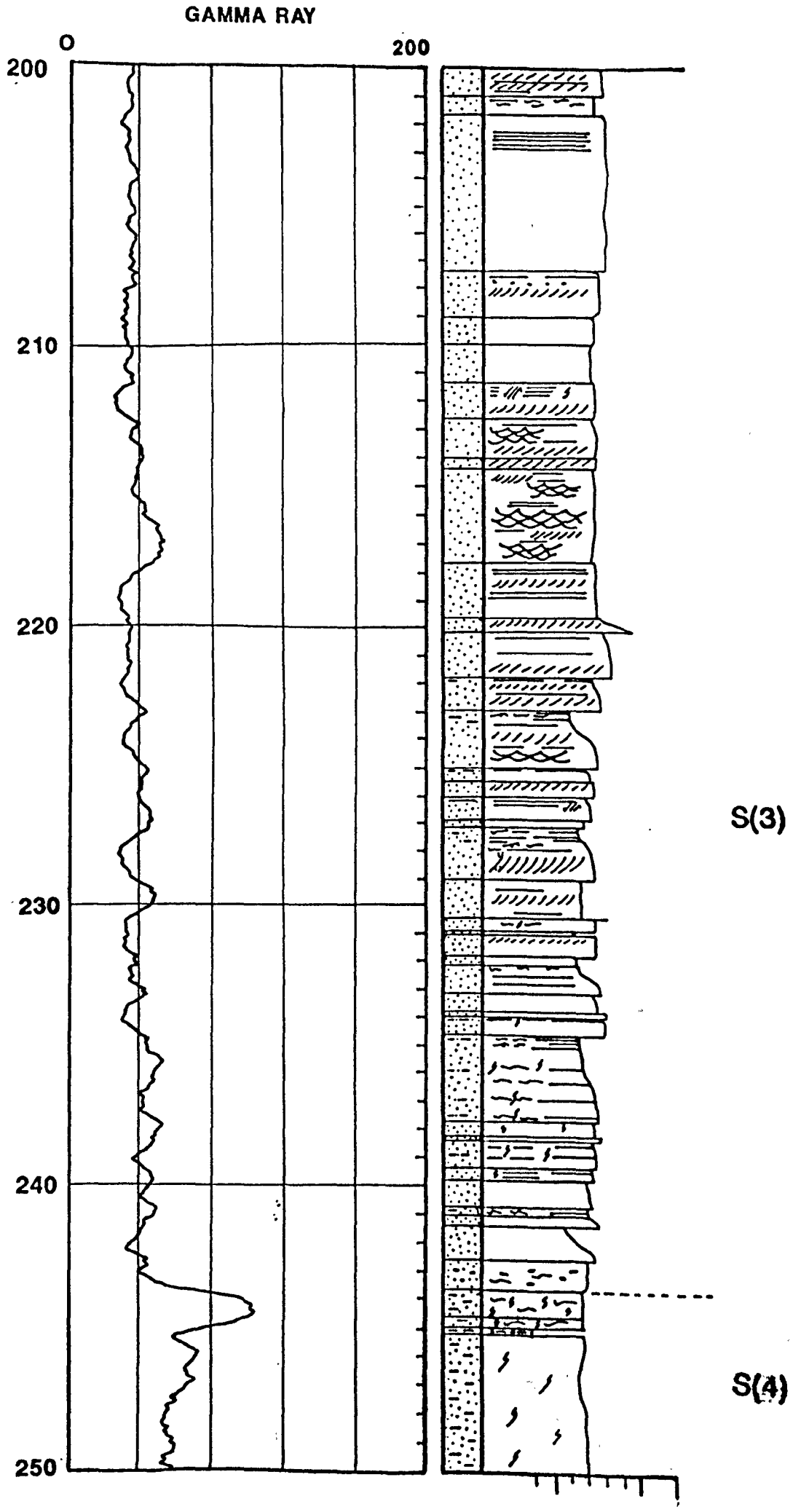
S(6)?
S(6)
S(7)
S(4)
S(6)
S(5)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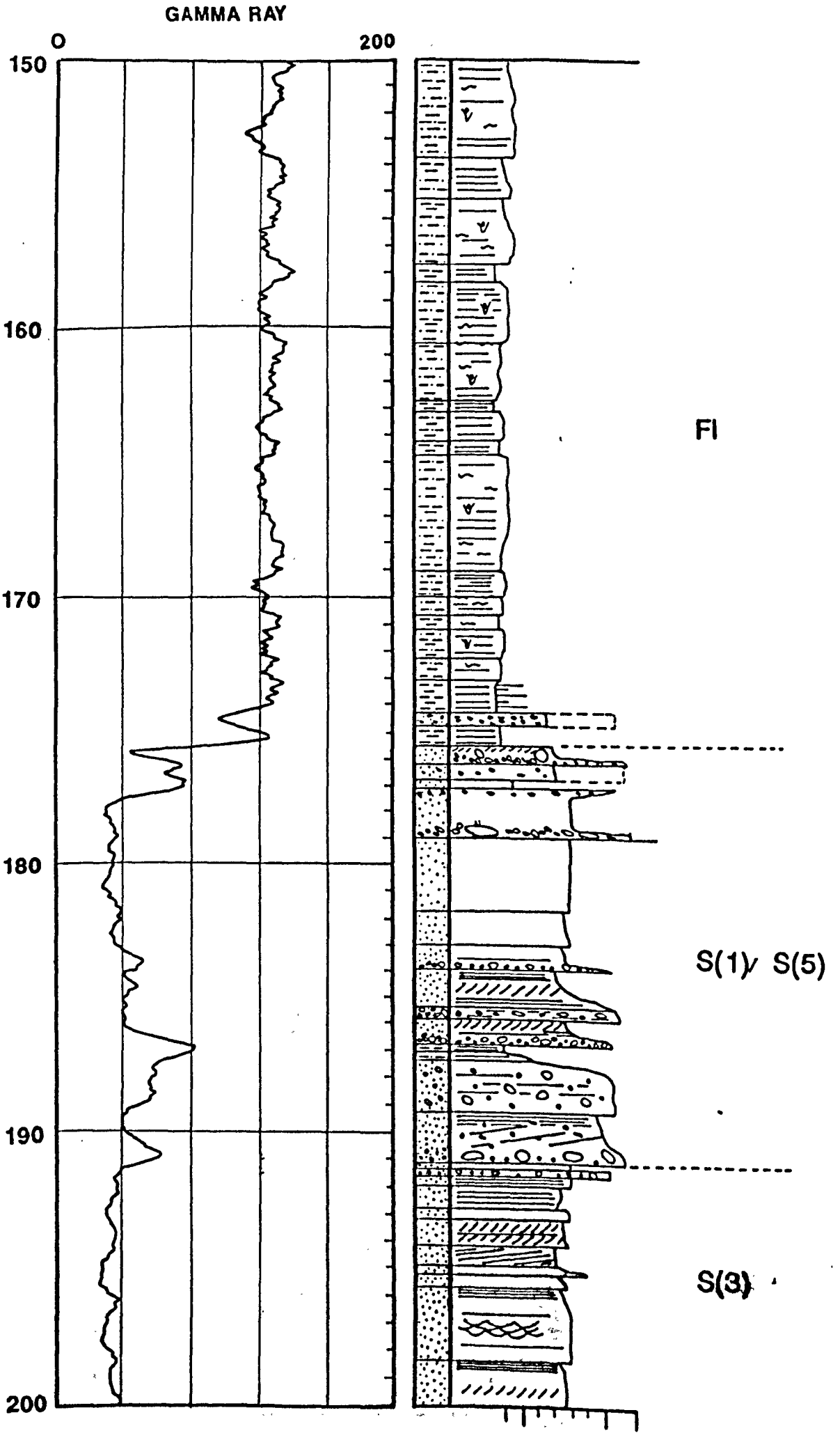
S(4)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200
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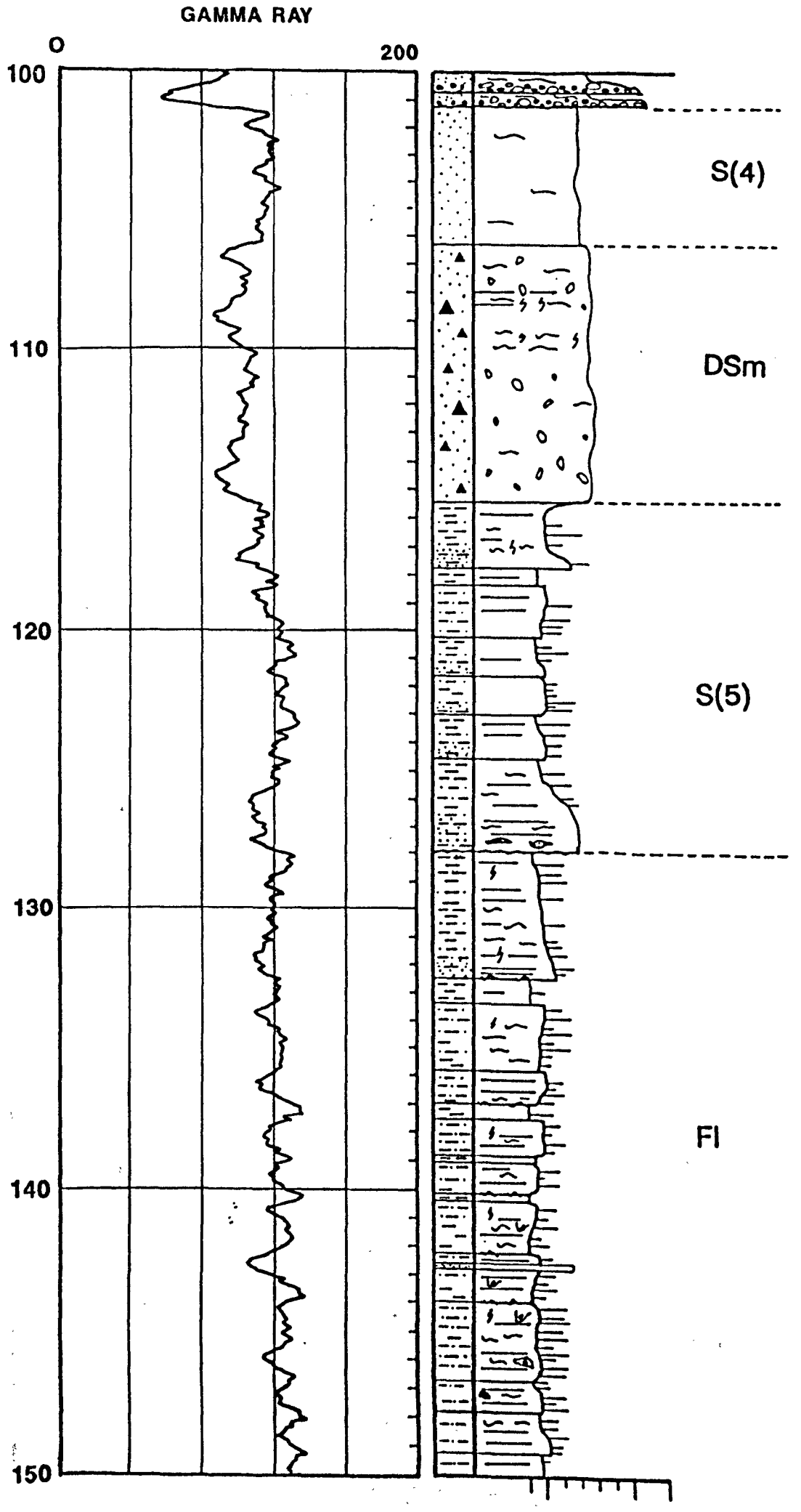
S(1)y S(5)
S(3)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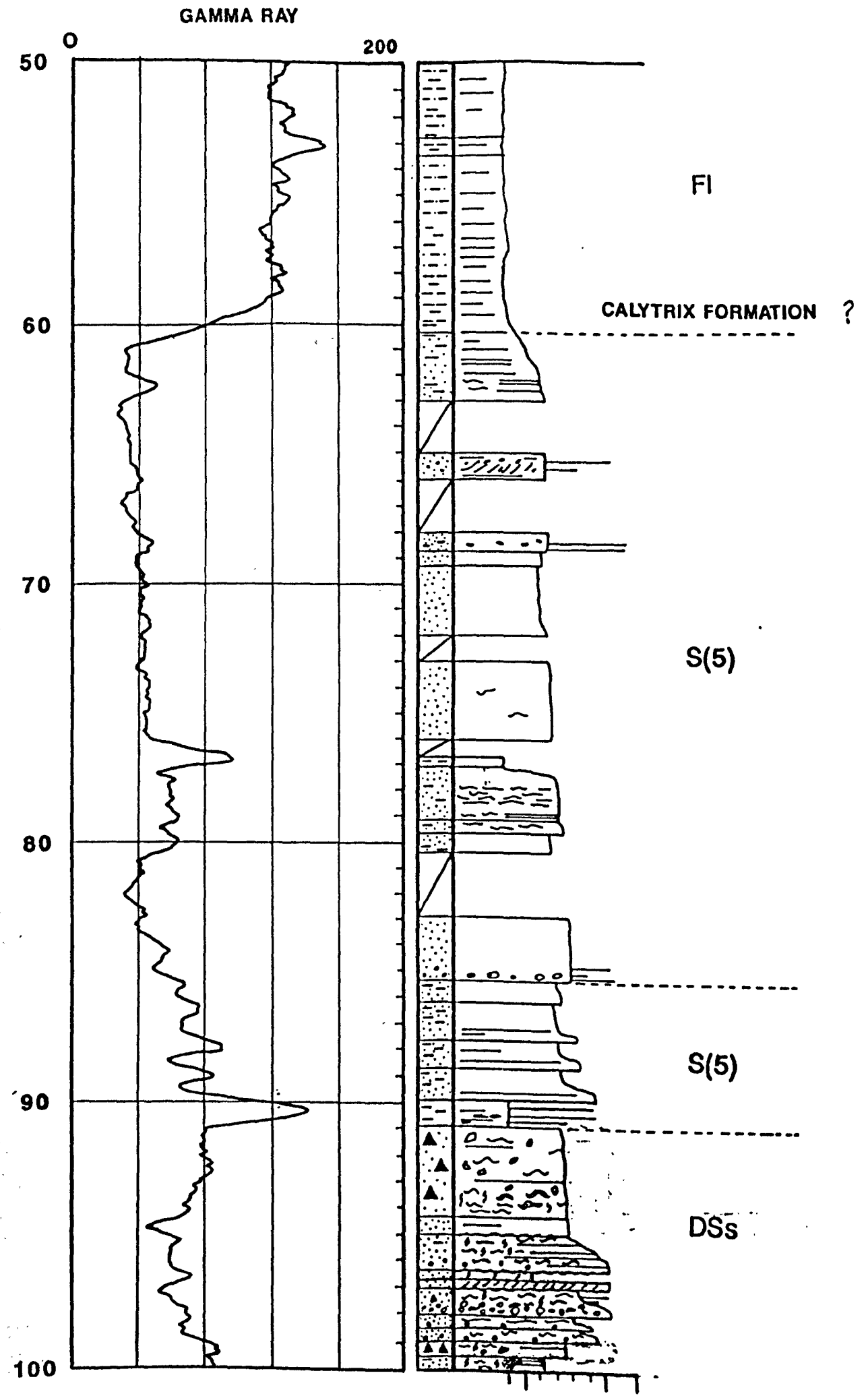
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S(5)
S(5)
DSs

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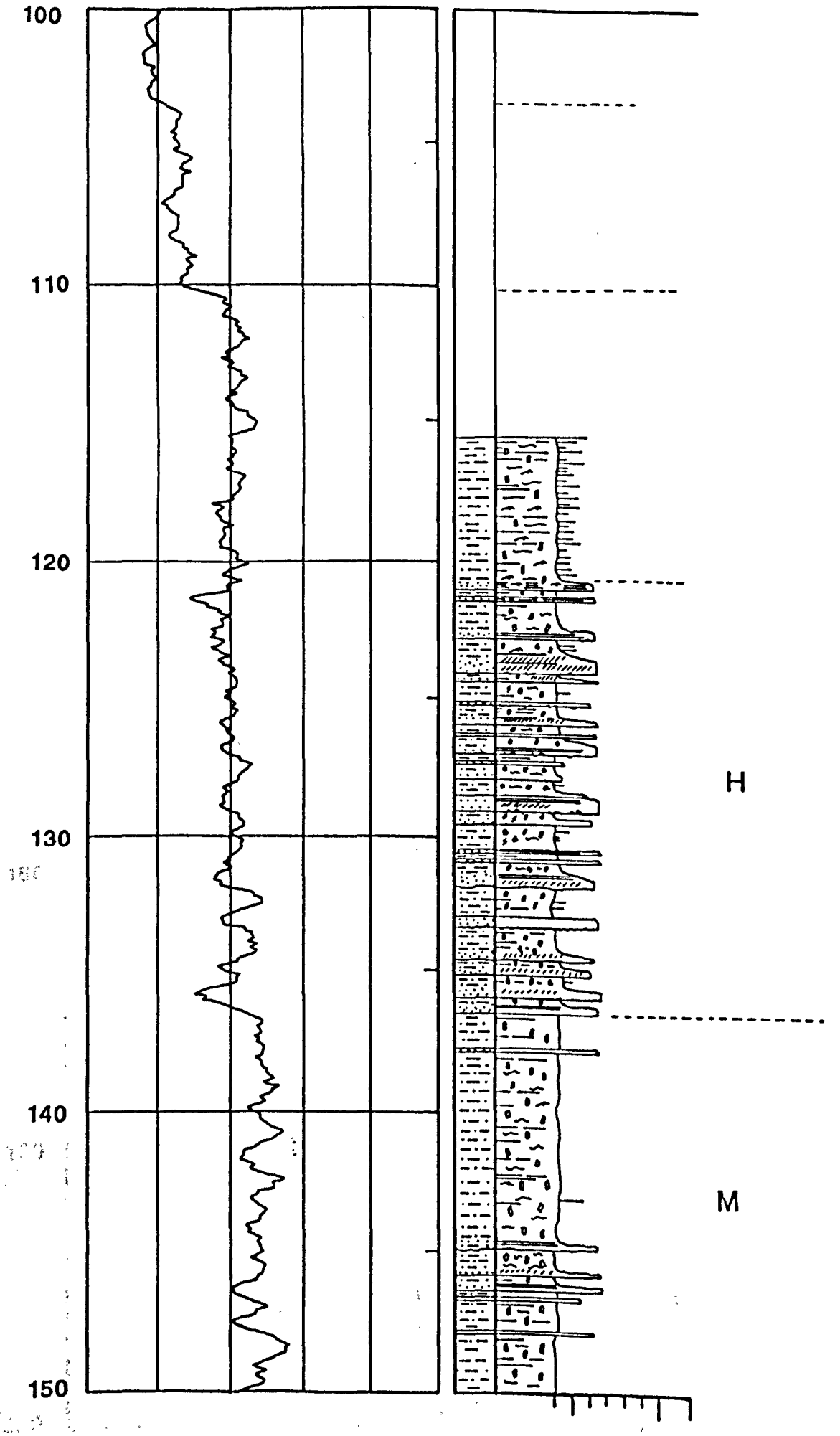
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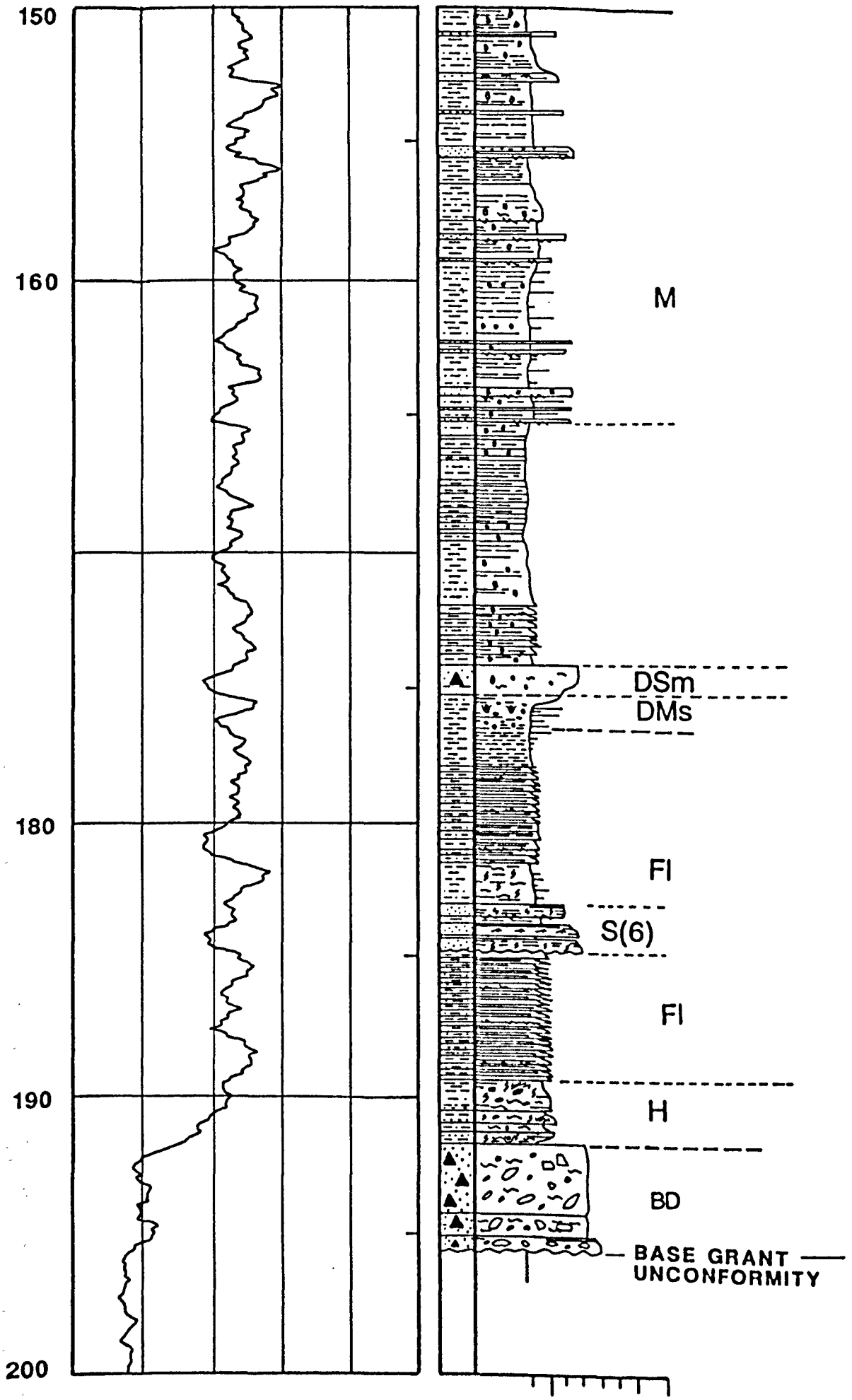
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DMs
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S(6)
FI
H
BD
BASE GRANT
UNCONFORMITY

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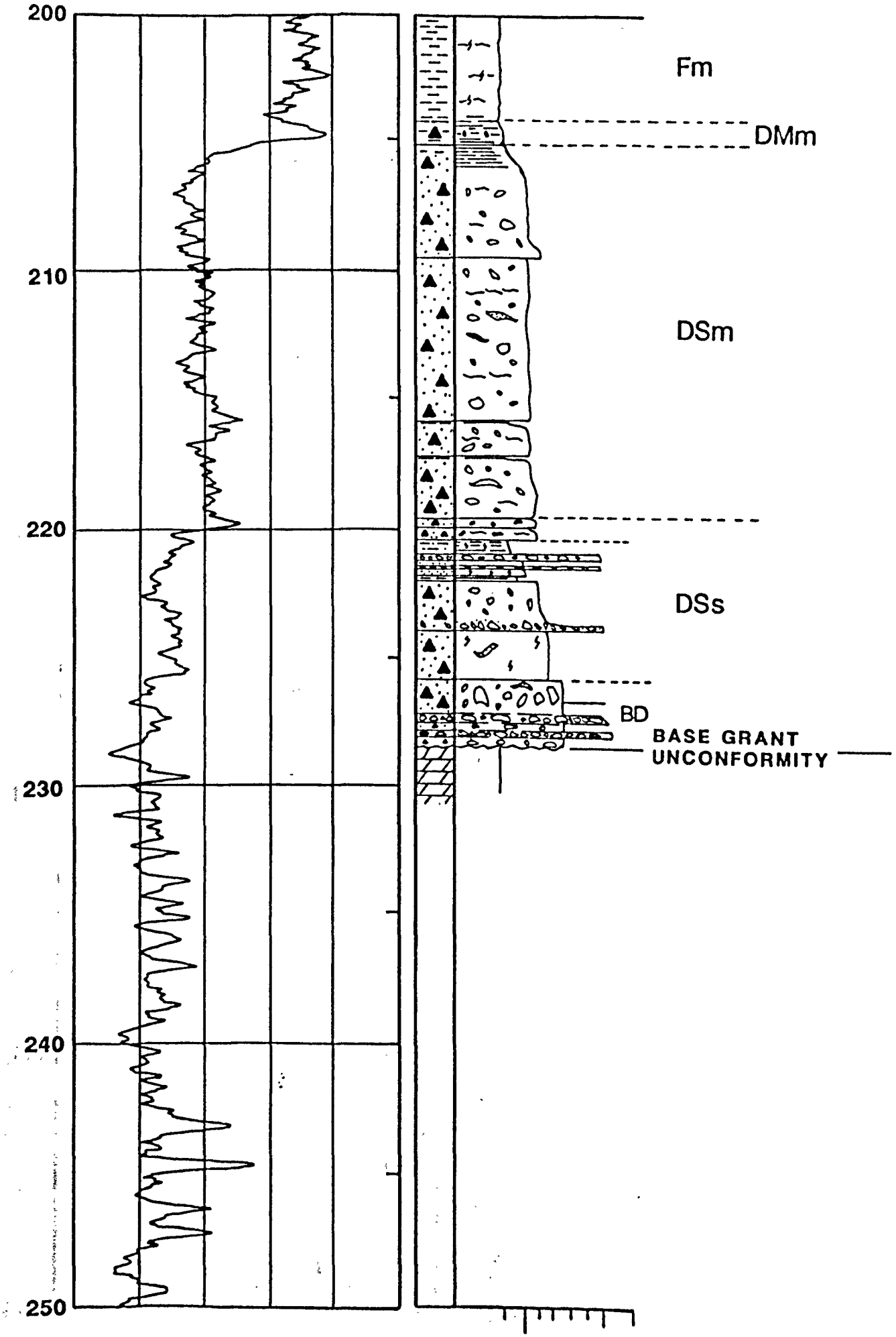
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DSm
DSs
BD
BASE GRANT
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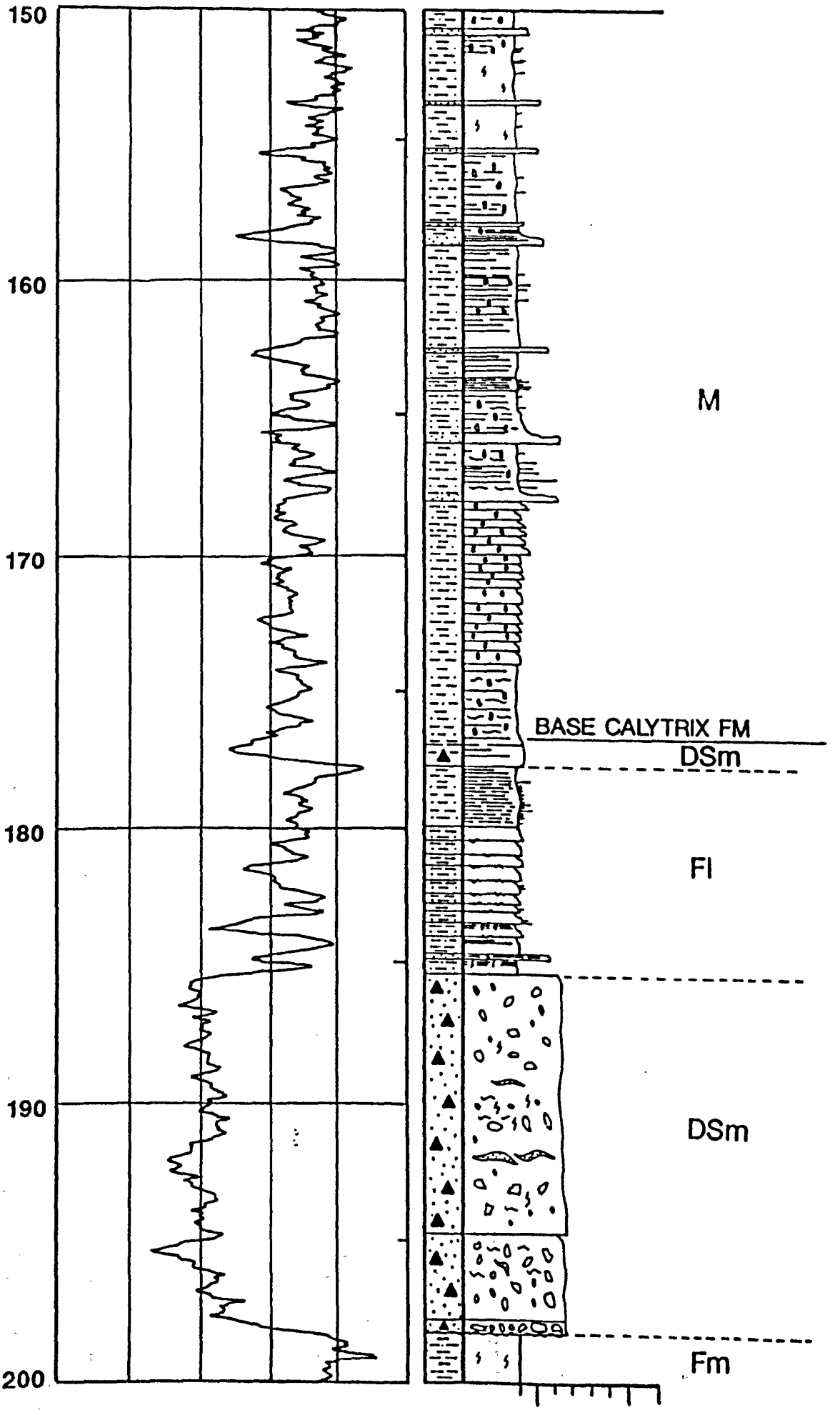
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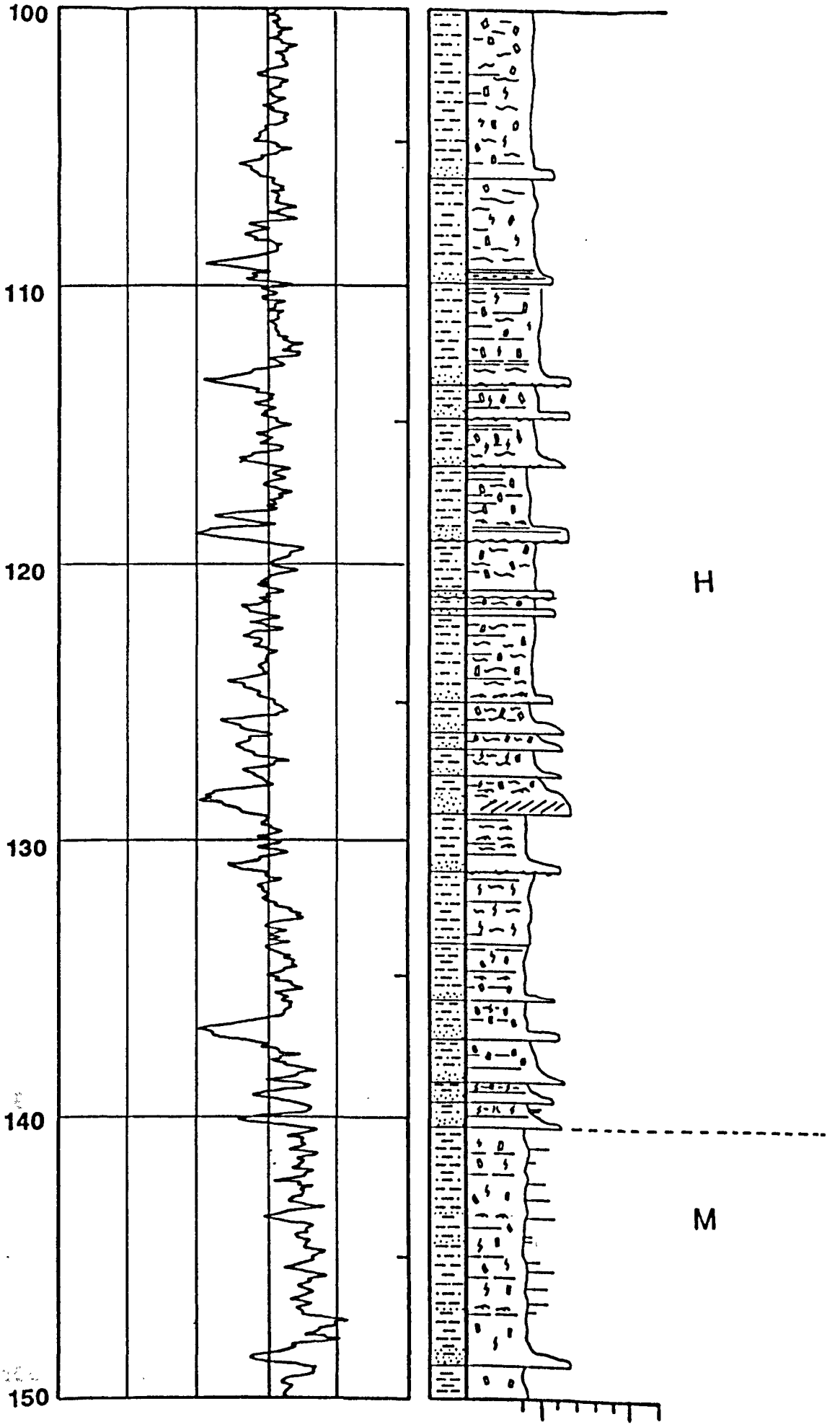
DSm
Fl
DSm
Fm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M

90
100
H

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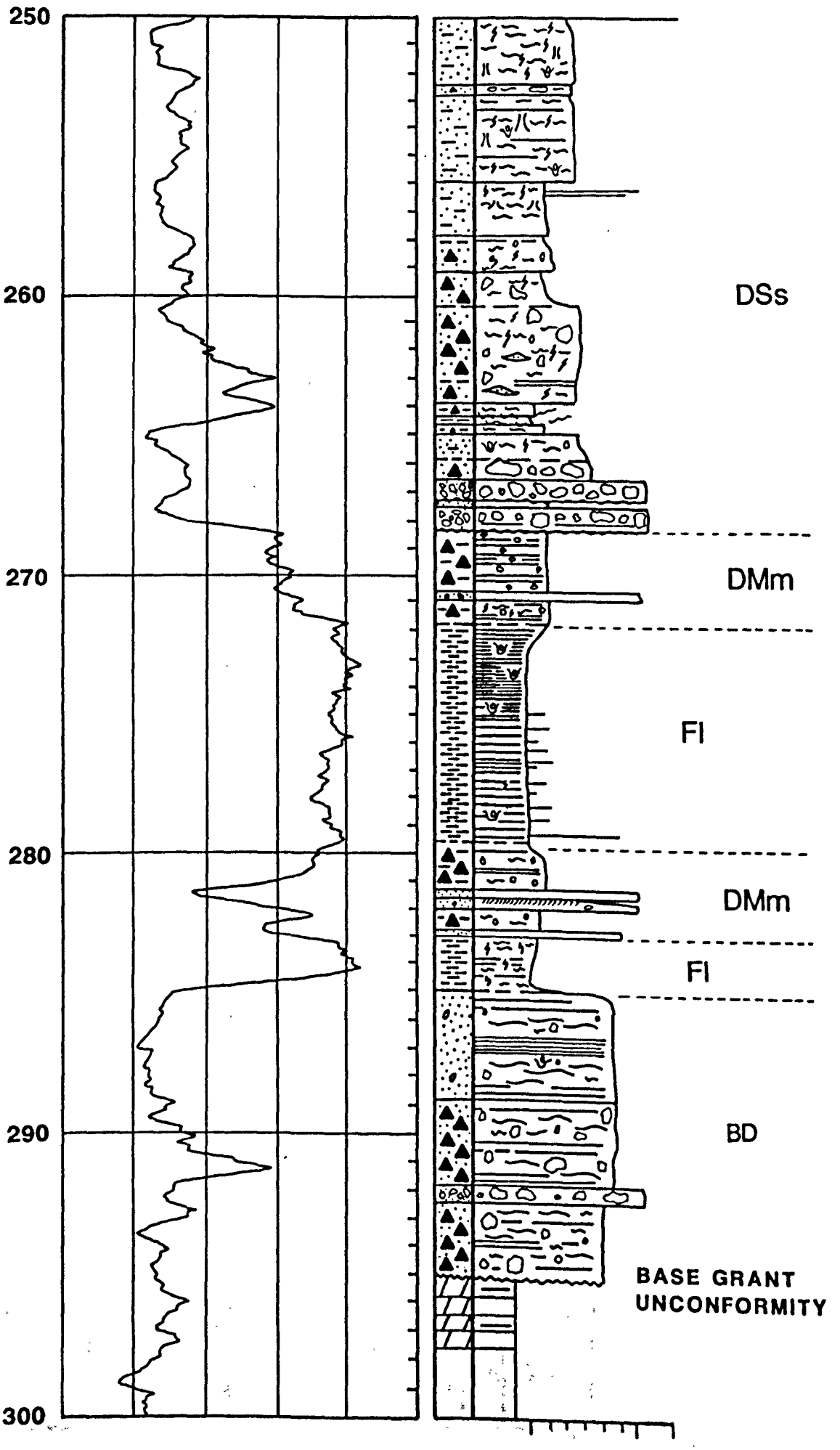
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DMm
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DMm
Fl
BD
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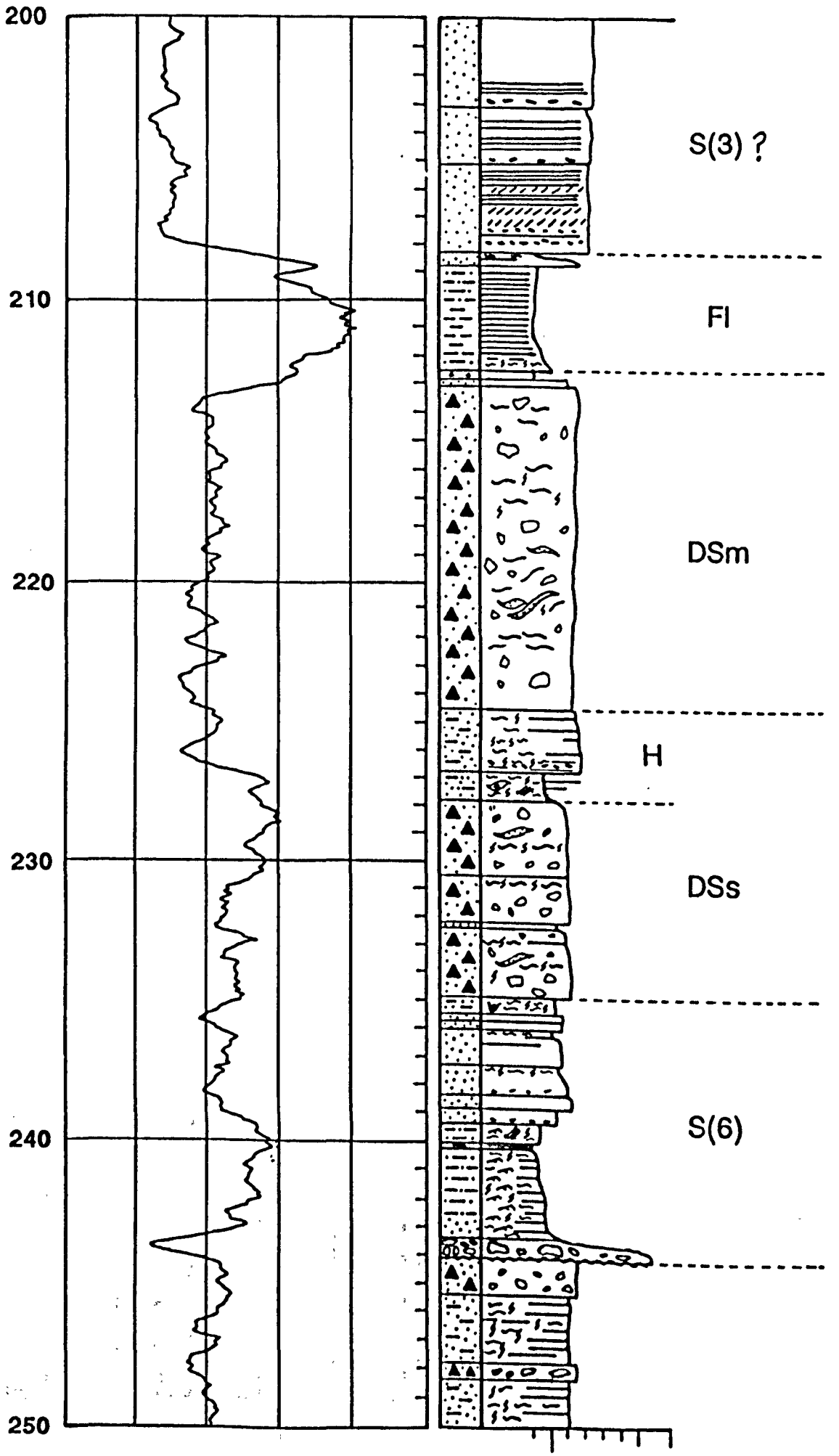
UNCONFORMITY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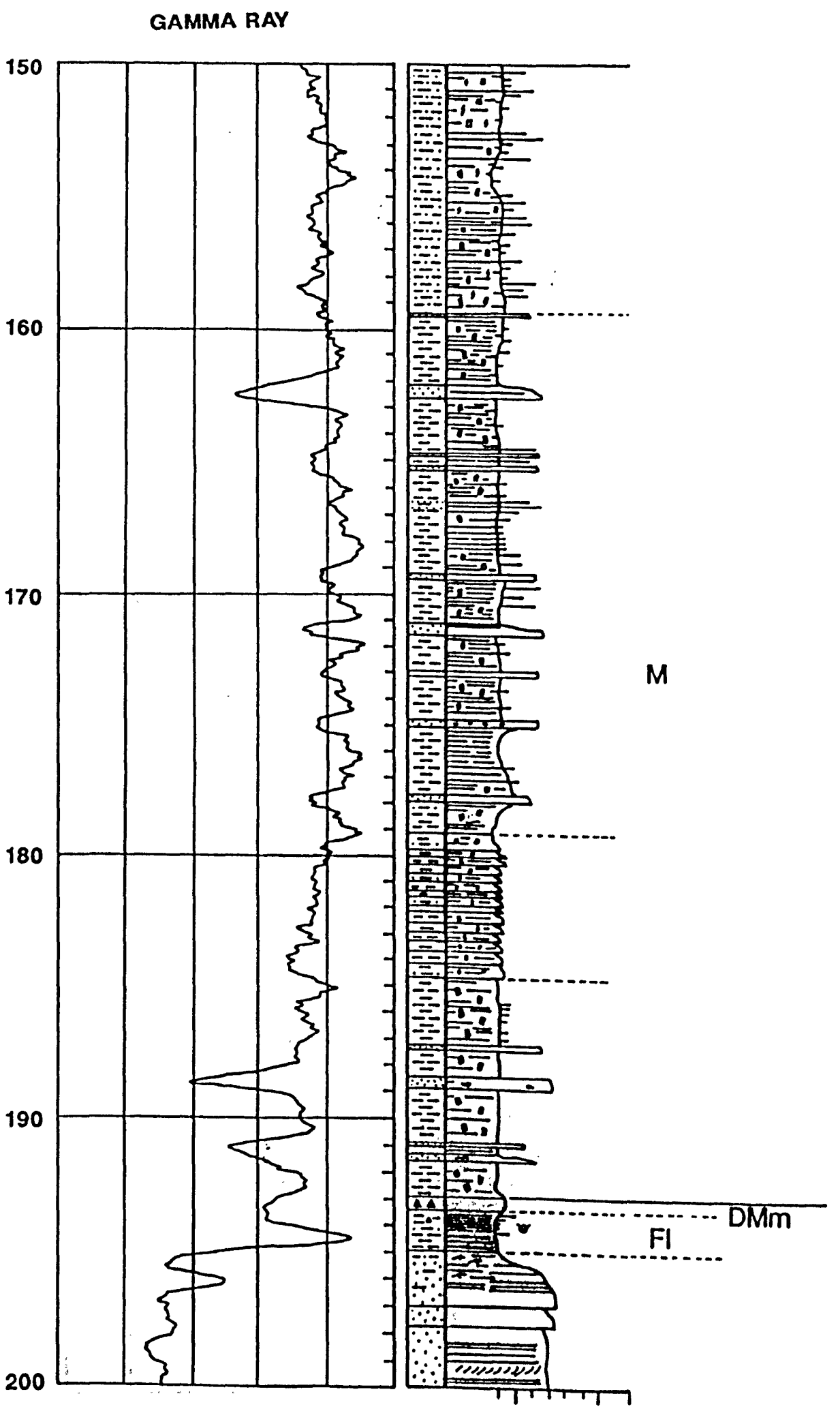
H
DSs
S(6)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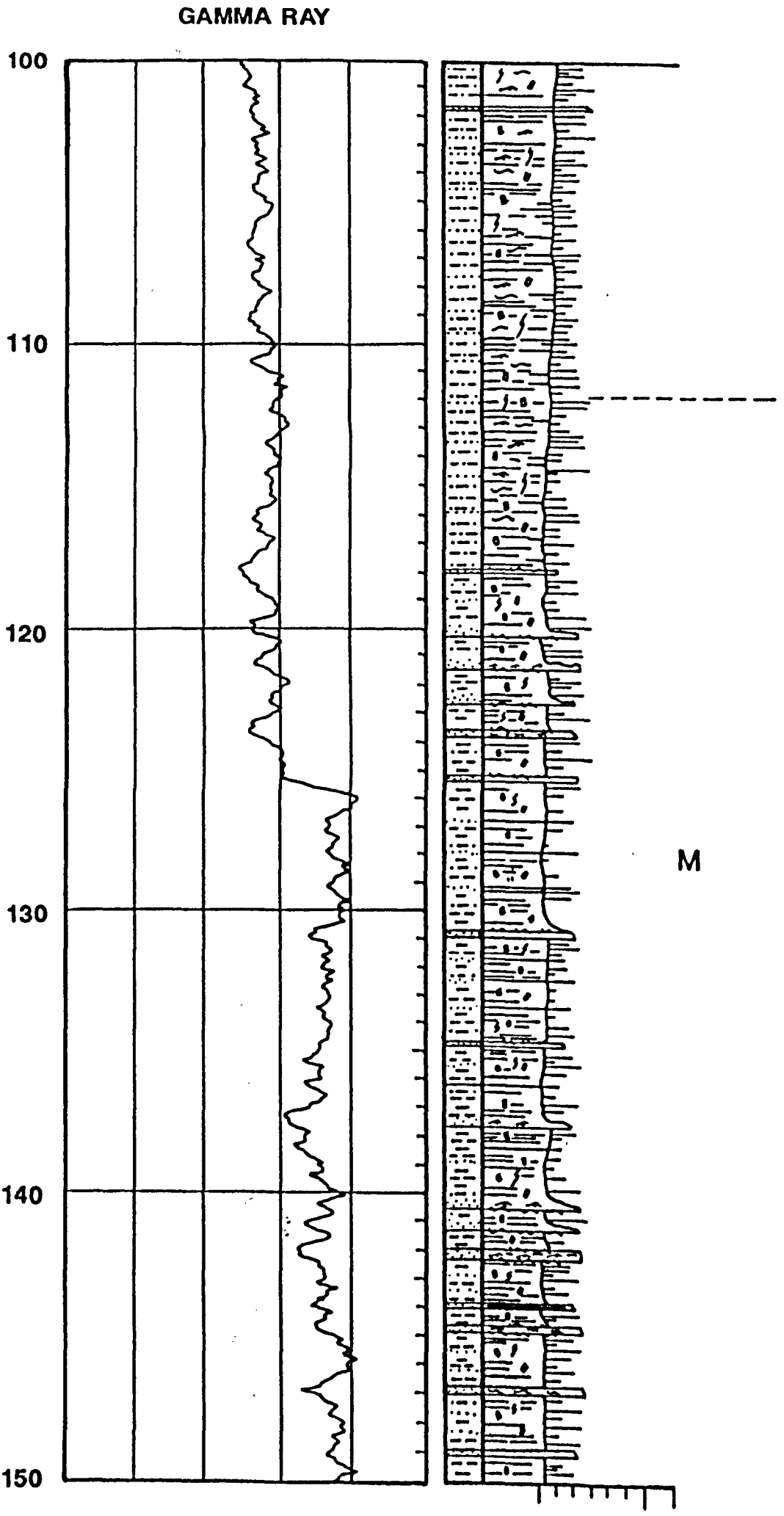
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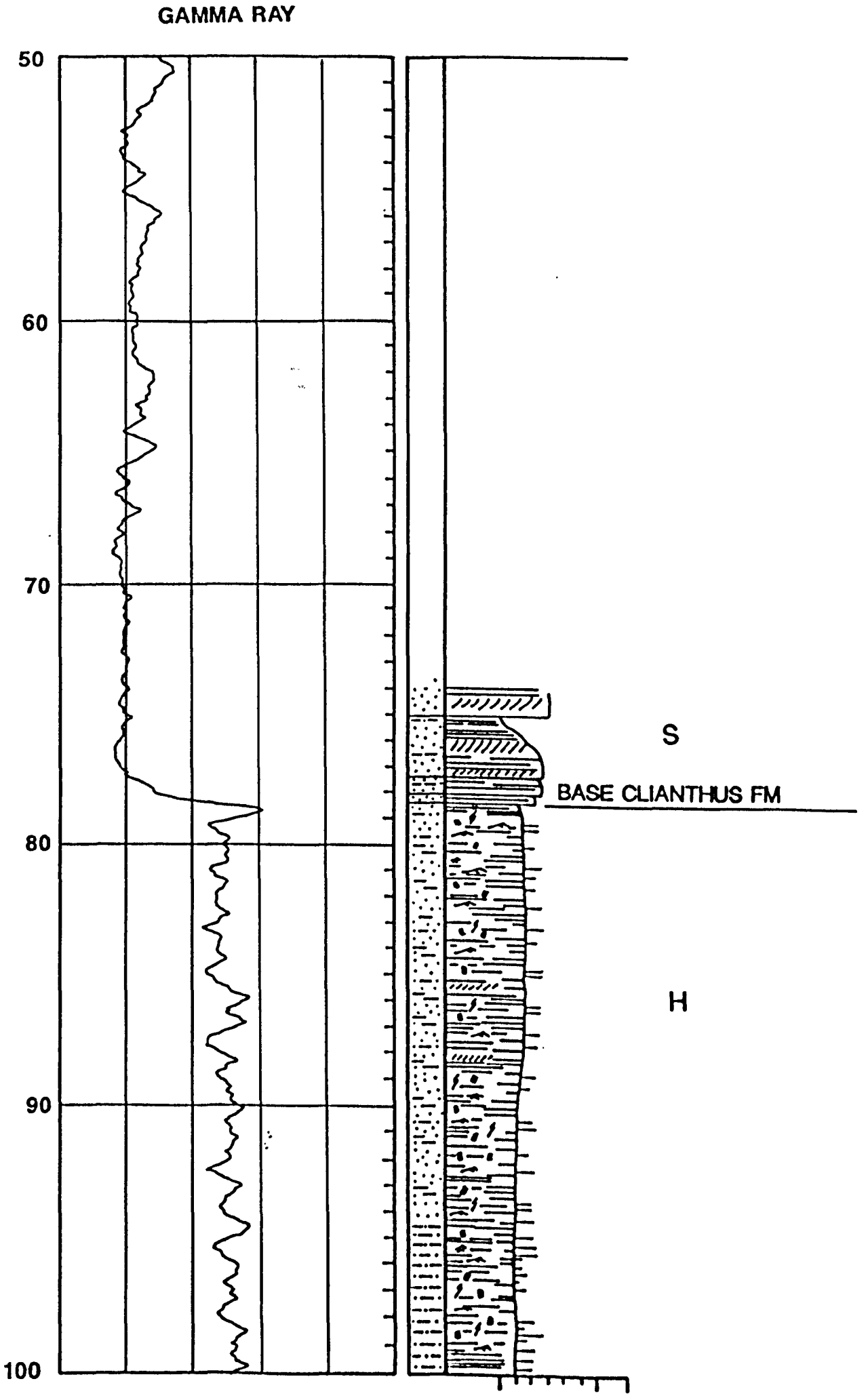
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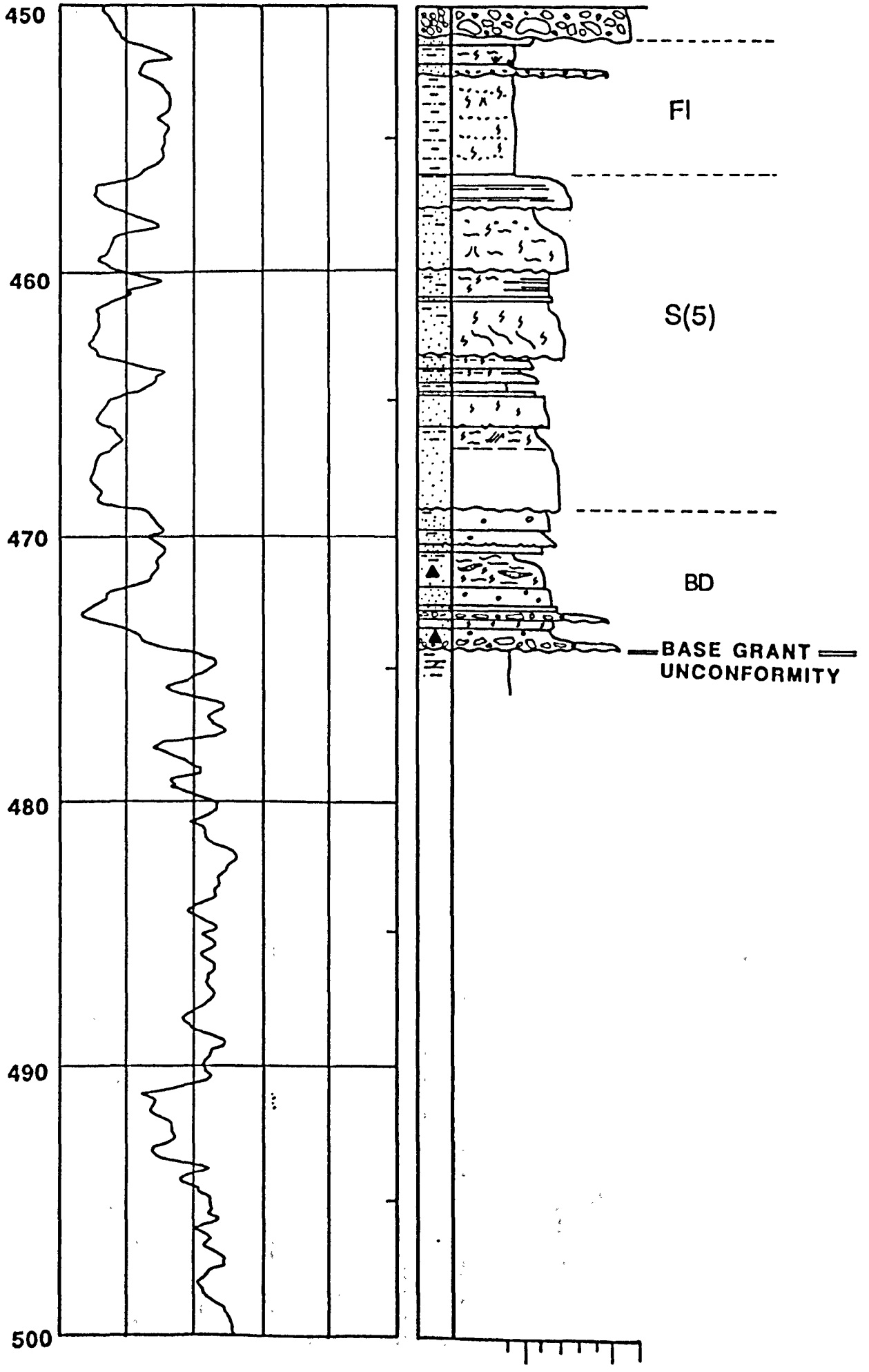
S
BASE CLIANTHUS FM
H

FICUS 1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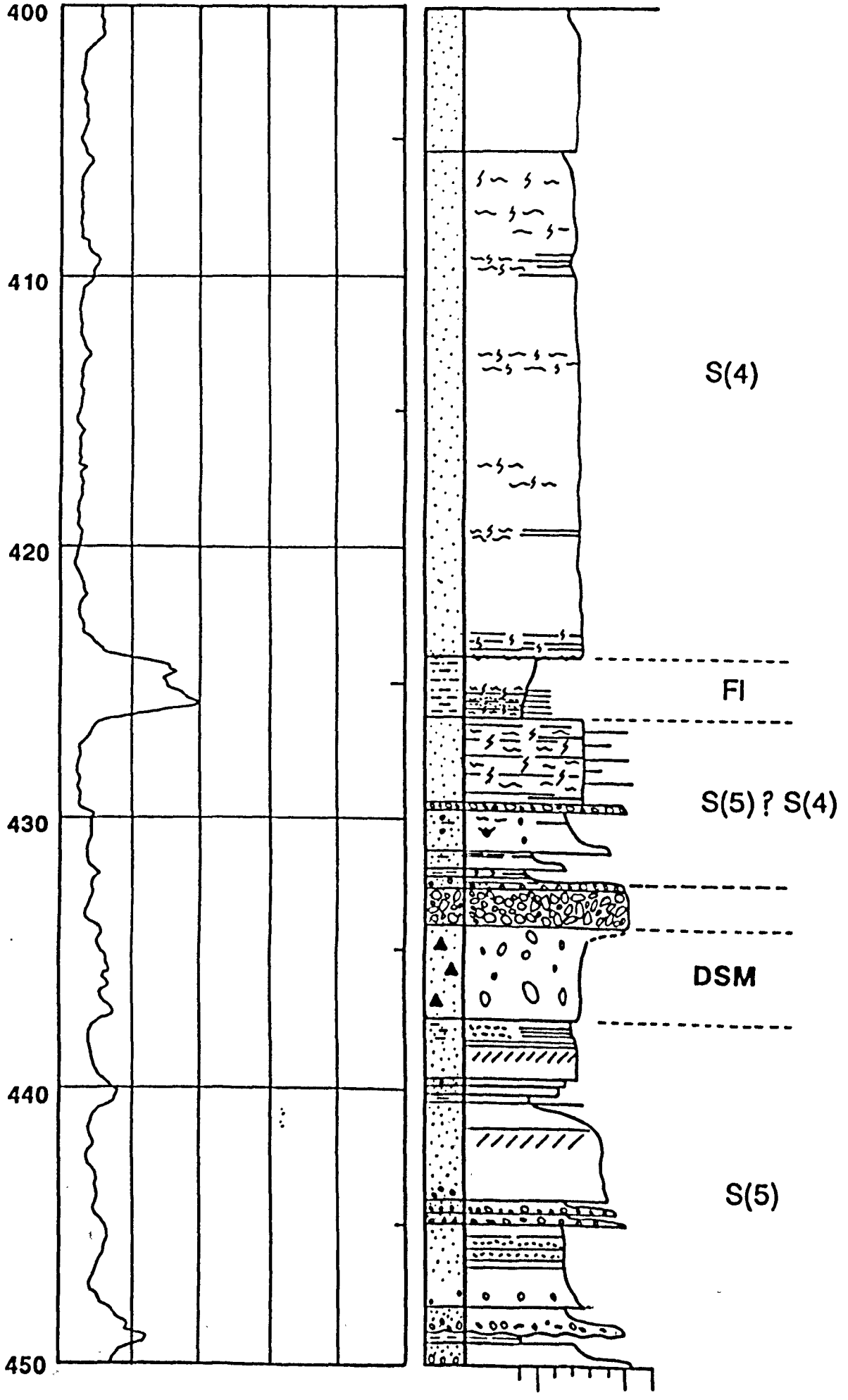
UNCONFORMITY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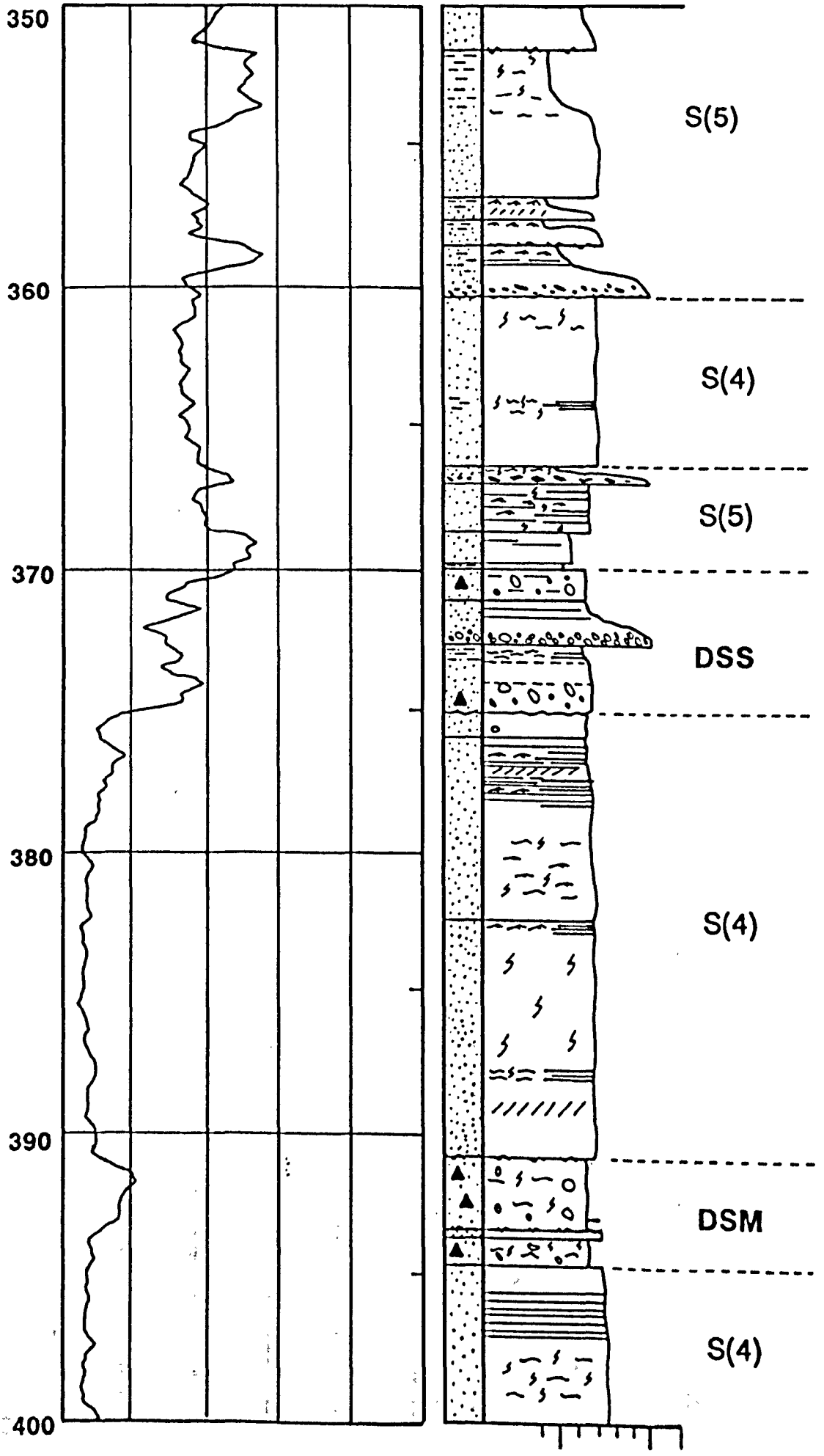
FI
S(5) ? S(4)
DSM
S(5)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S(5)
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S(4)
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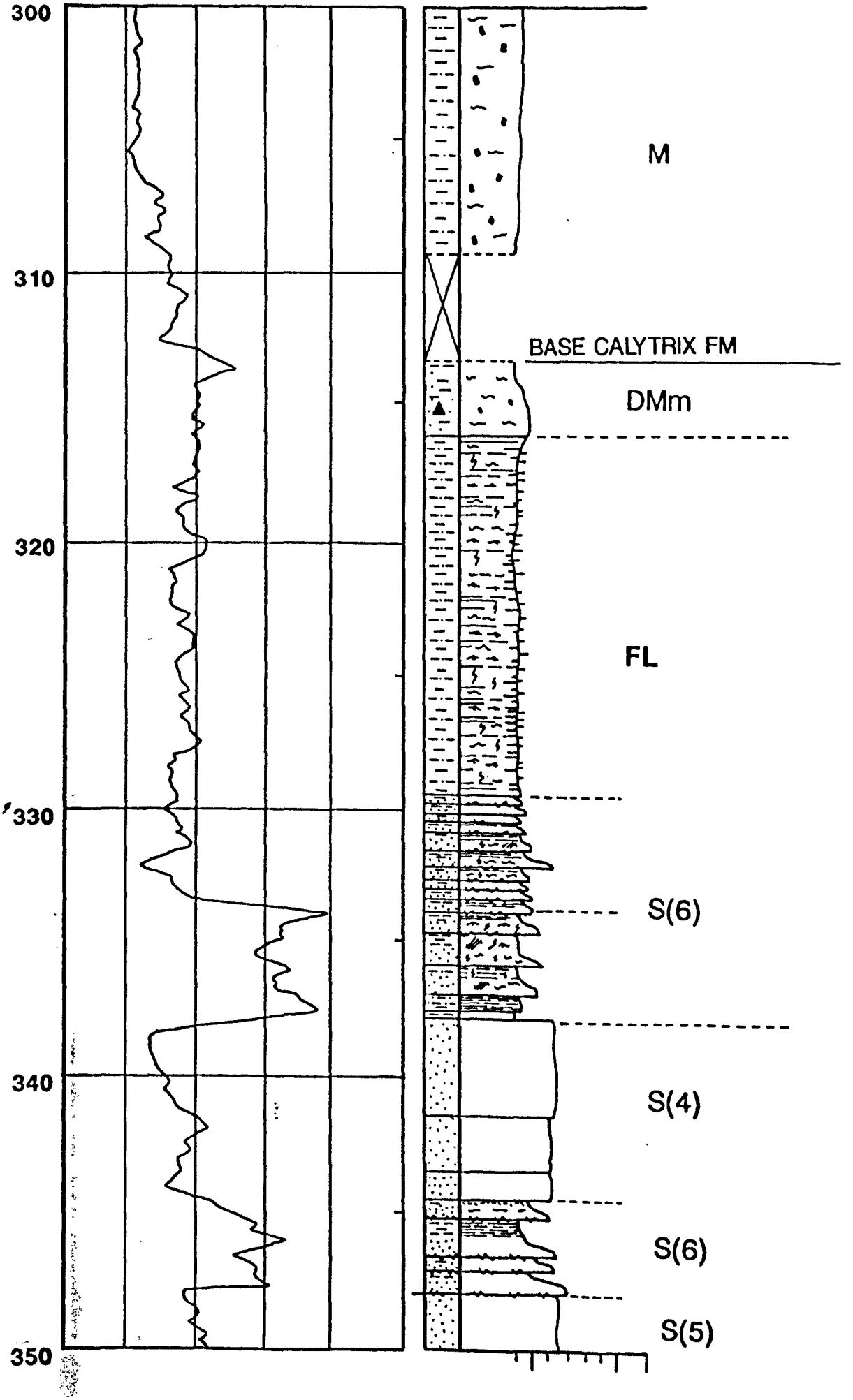
S(4)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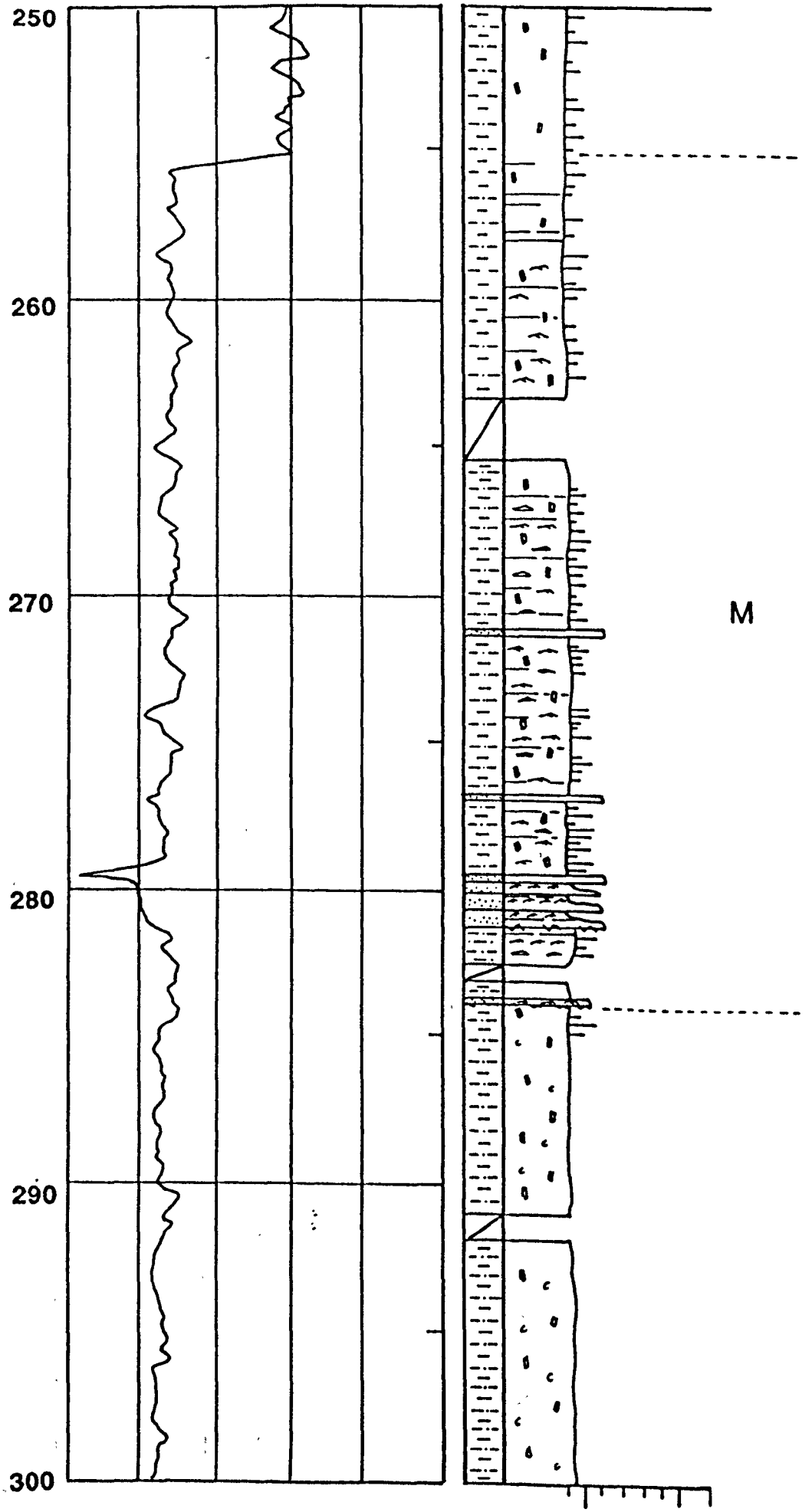
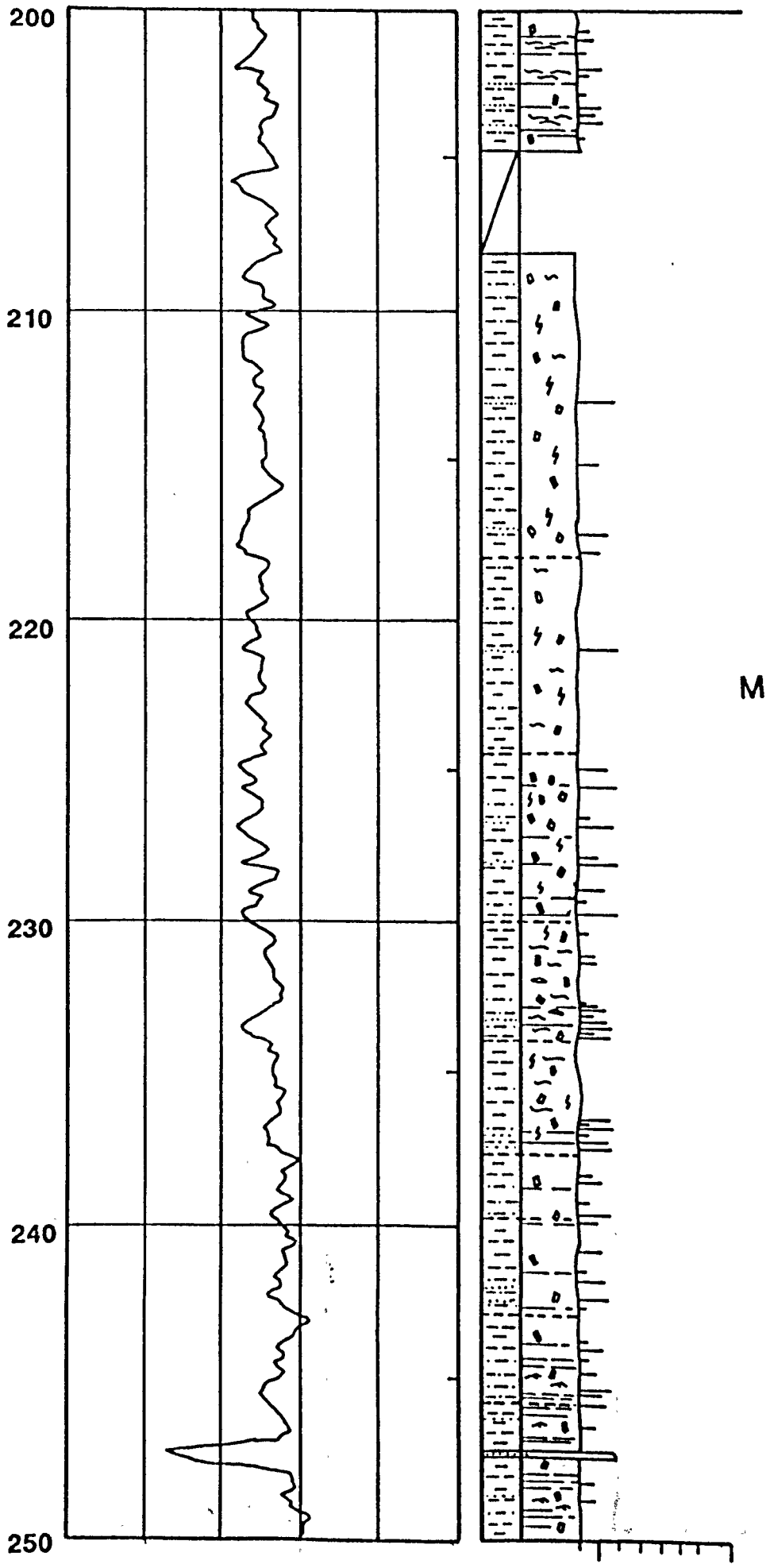
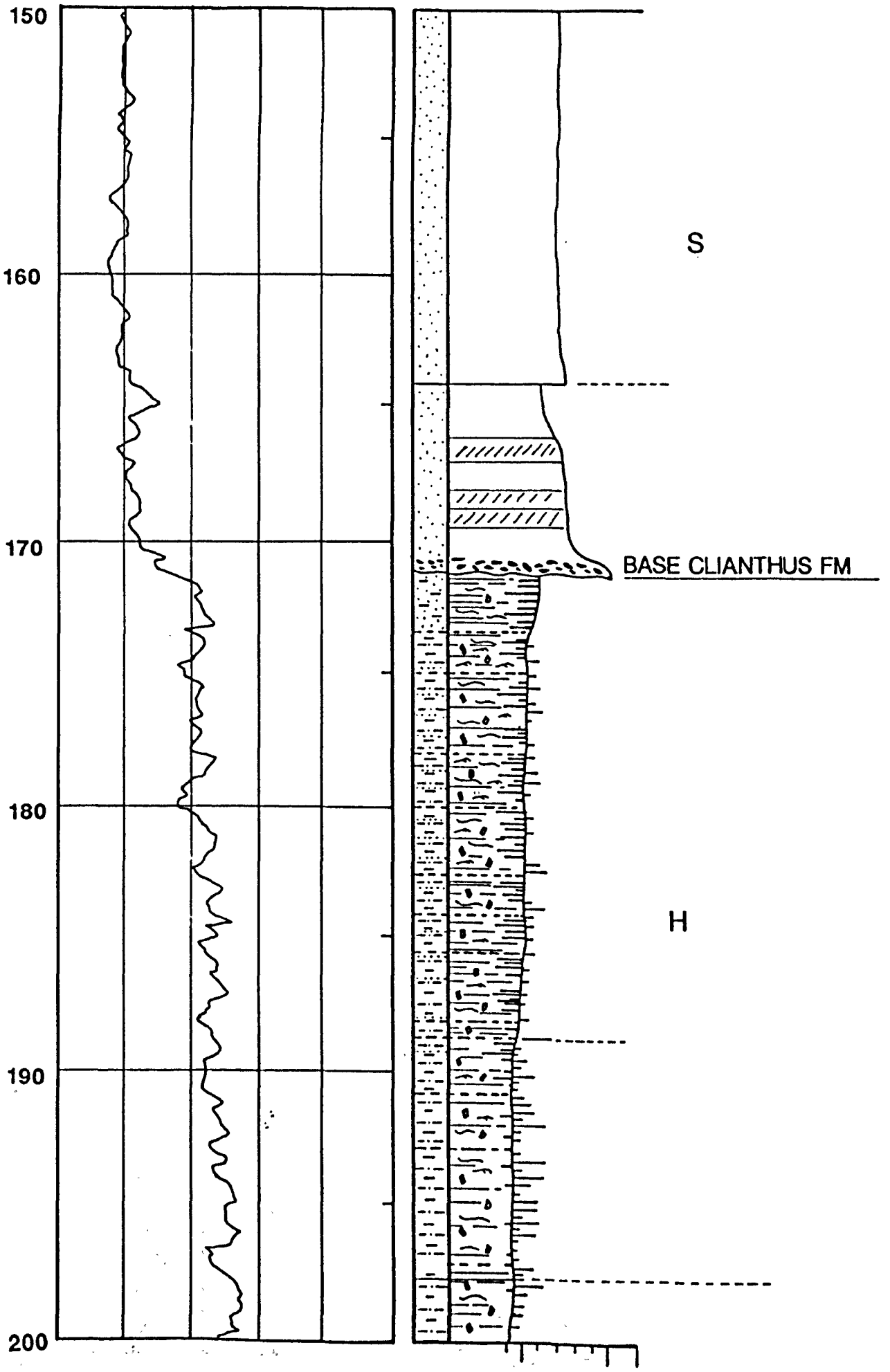
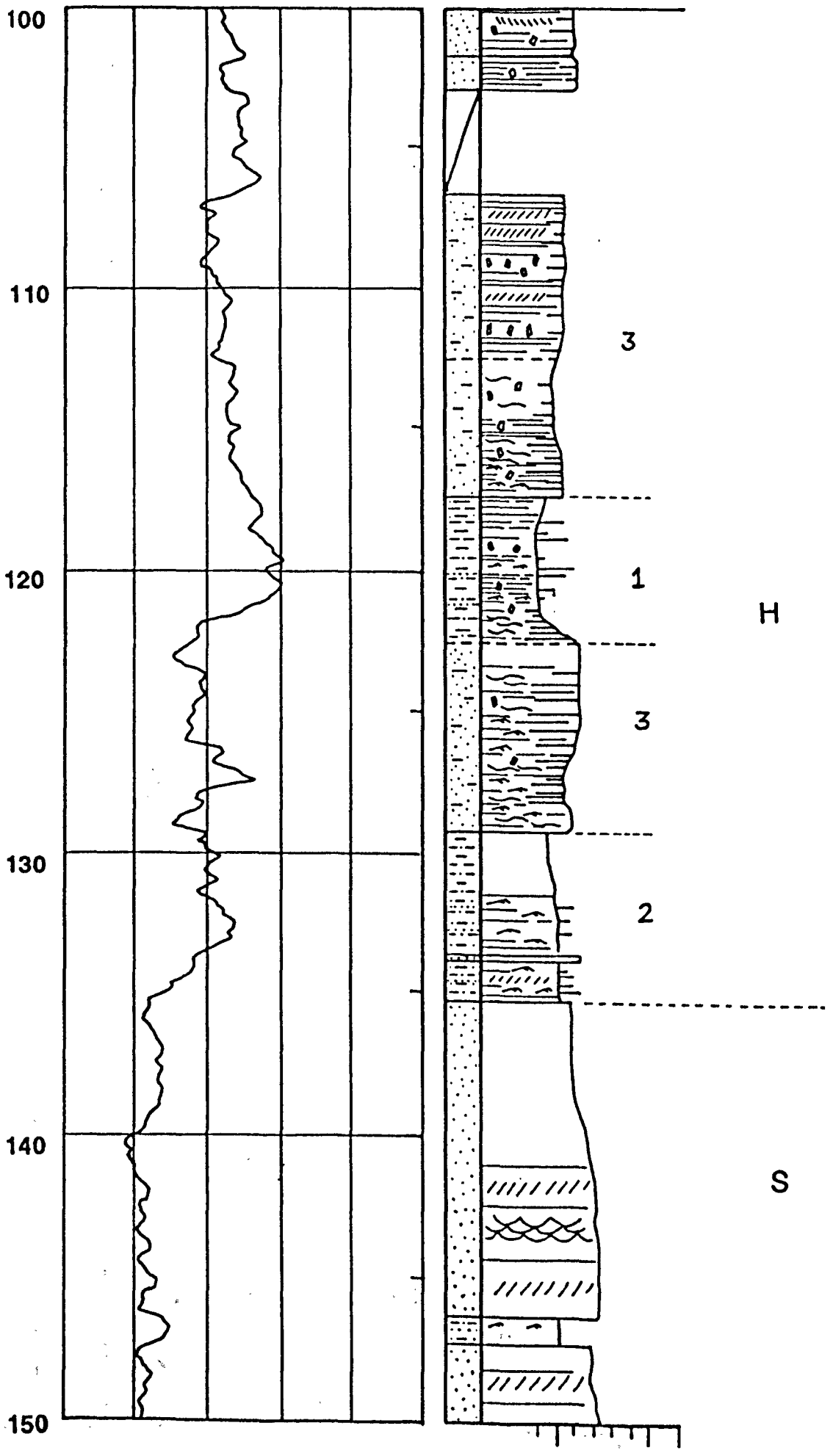
BASE CALYTRIX FM
DMm
FL
S(6)
S(4)
S(6)
S(5)


250
260
270
280
290
300
M

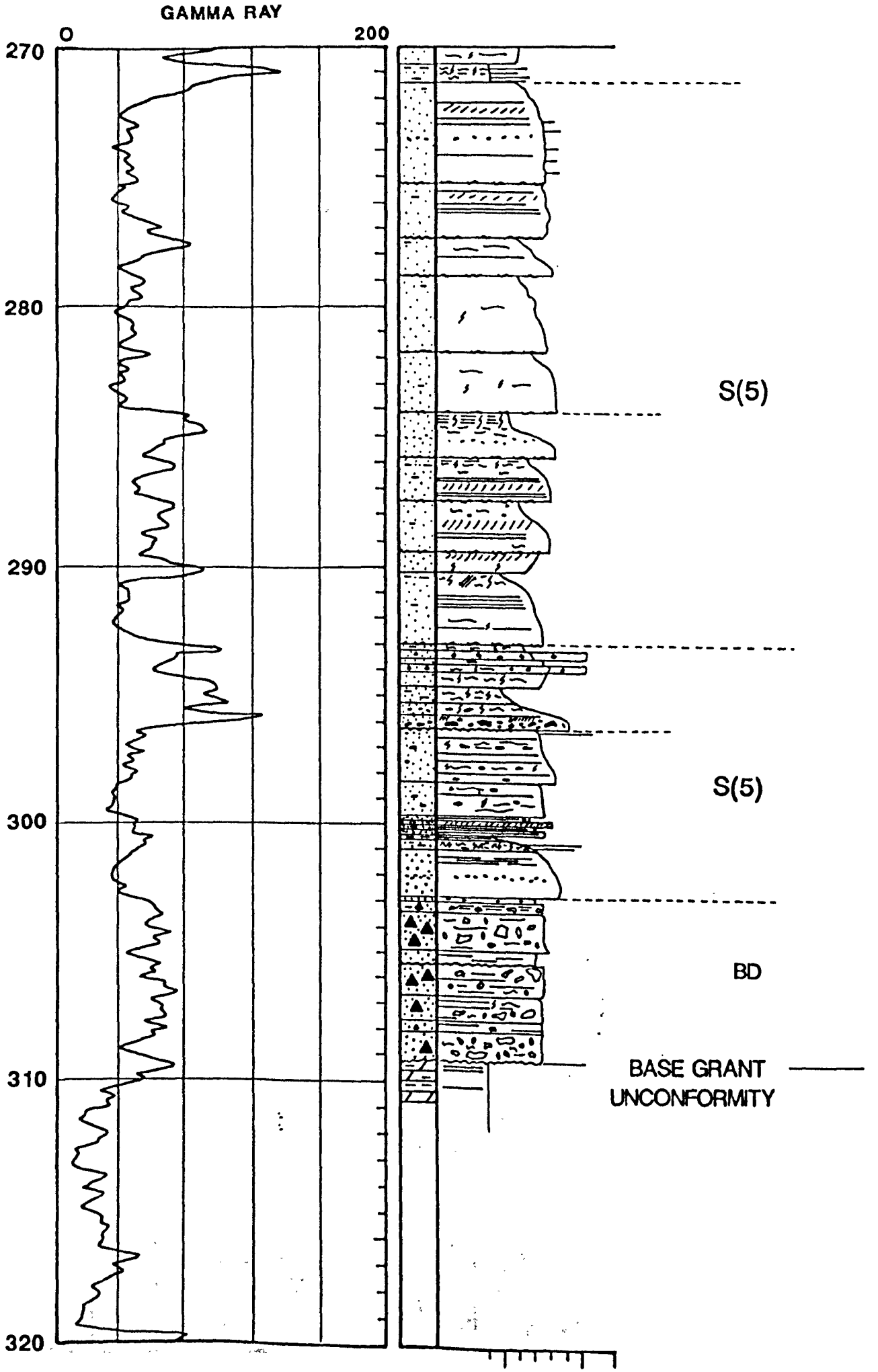

200
210
220
230
240
250
M

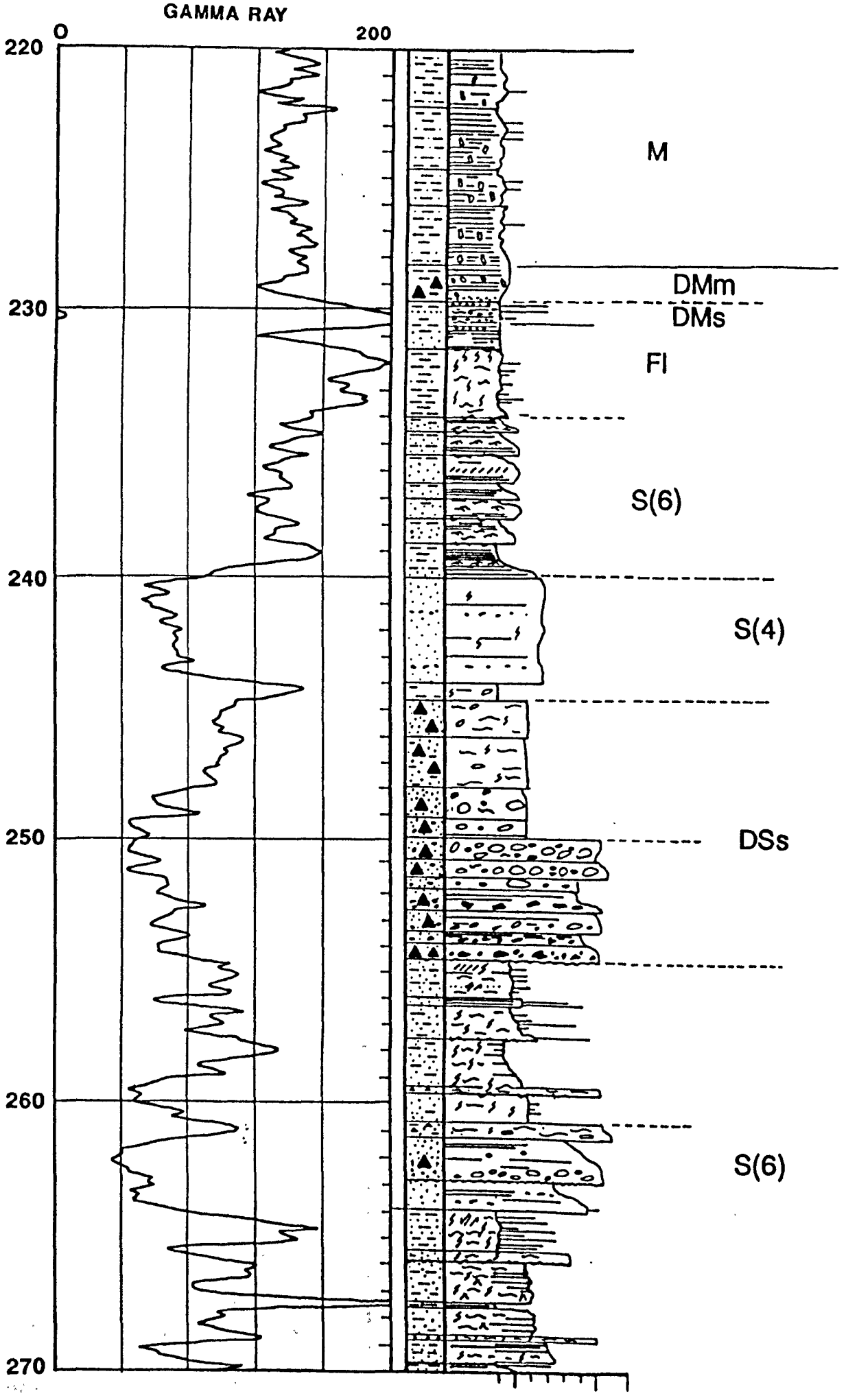

150
160
170
180
190
200
S
BASE CLIANTHUS FM
H

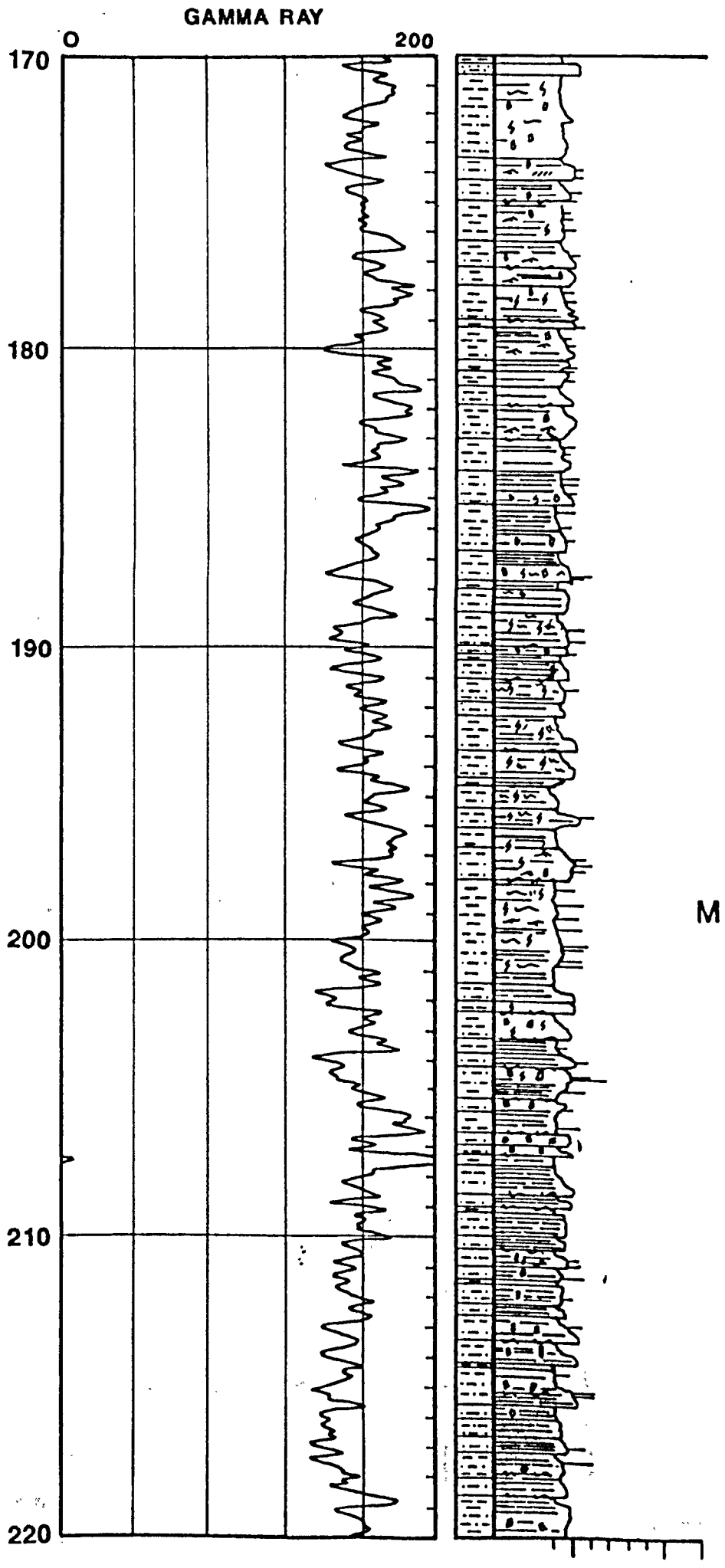

100
110
120
130
140
150
3
1
H
3
2
S

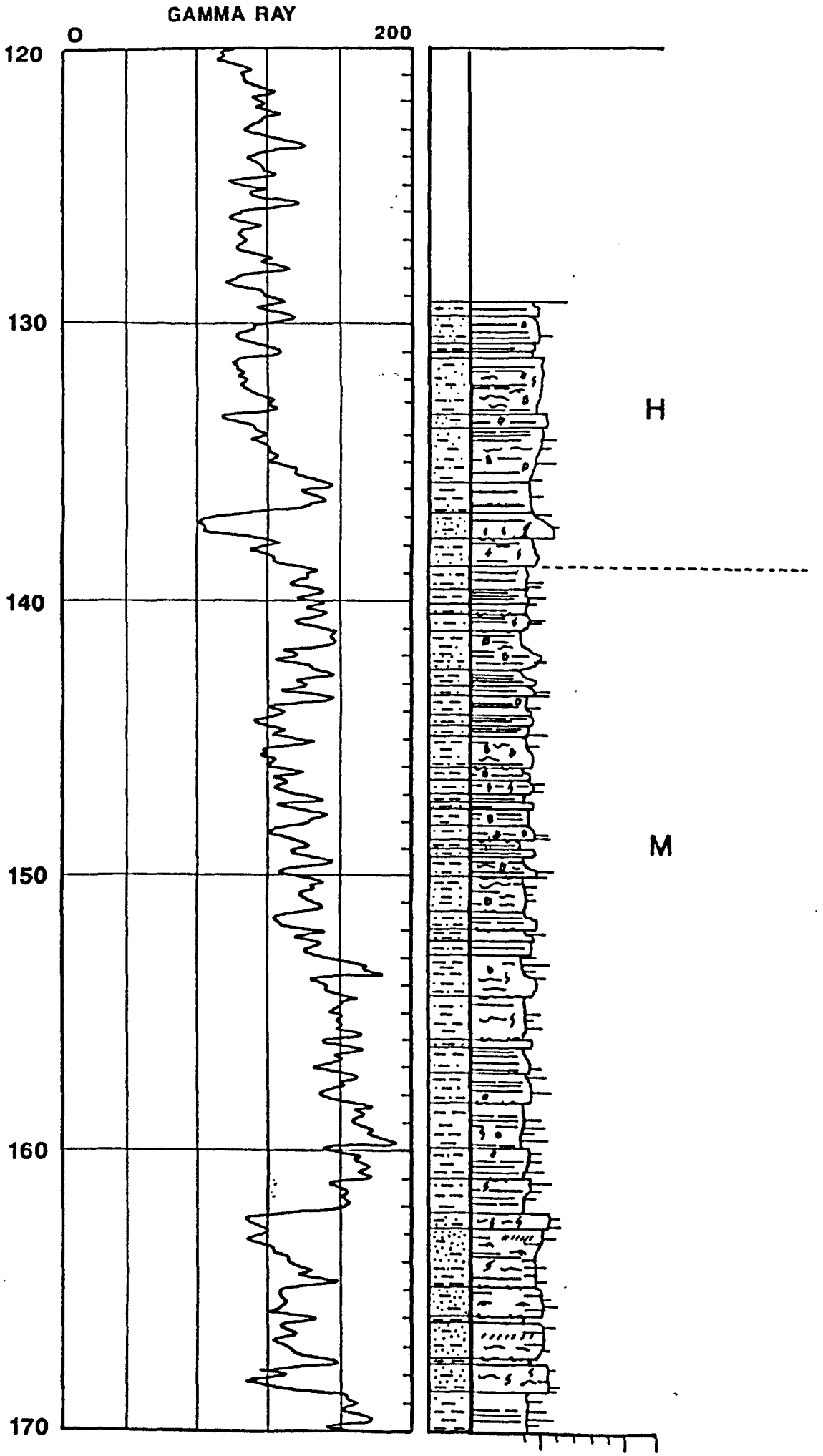
100
3

HALGANIA 1

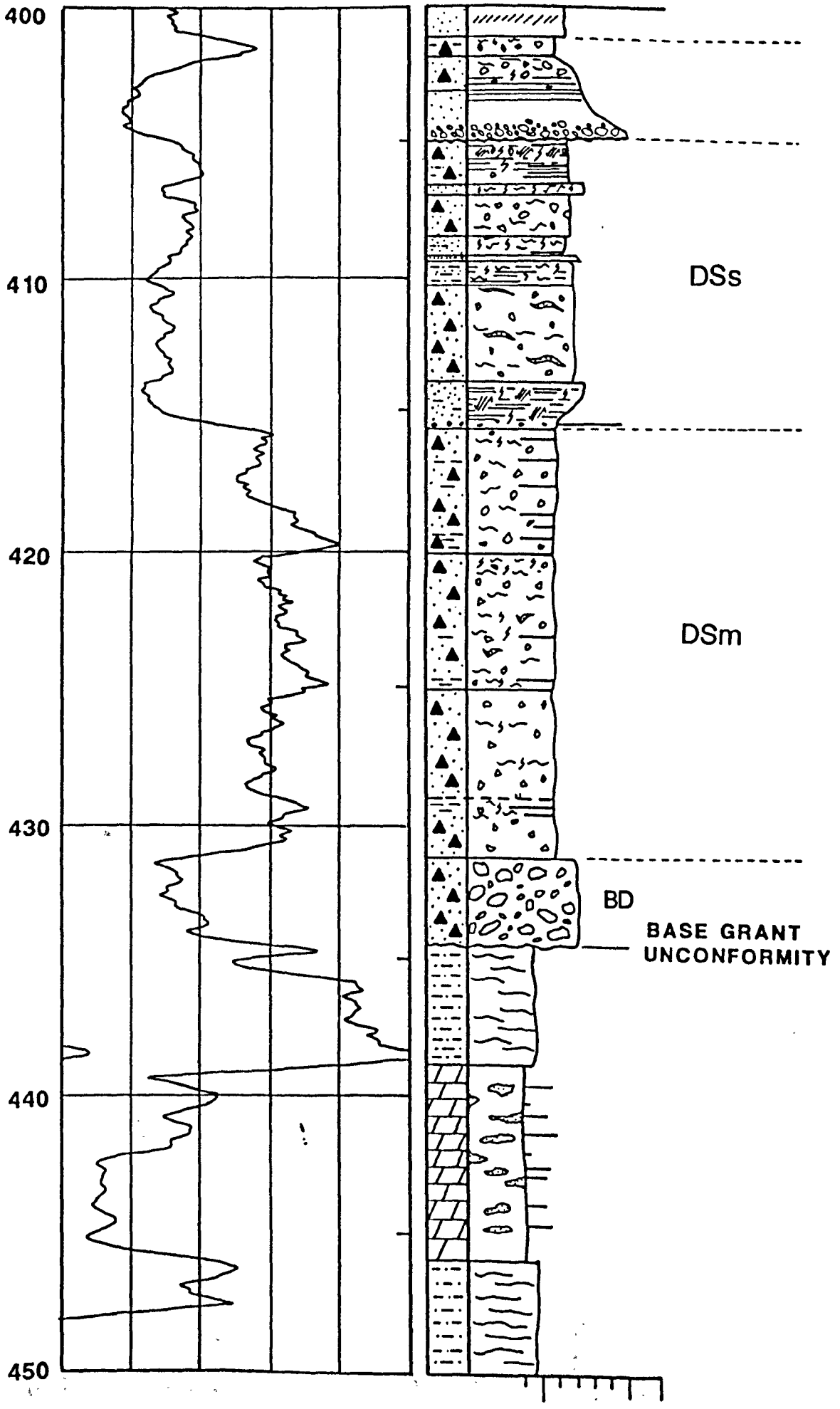

GAMMA RAY
0
200
270
280
290
300
310
320
S(5)
S(5)
BD
BASE GRANT
UNCONFORMITY

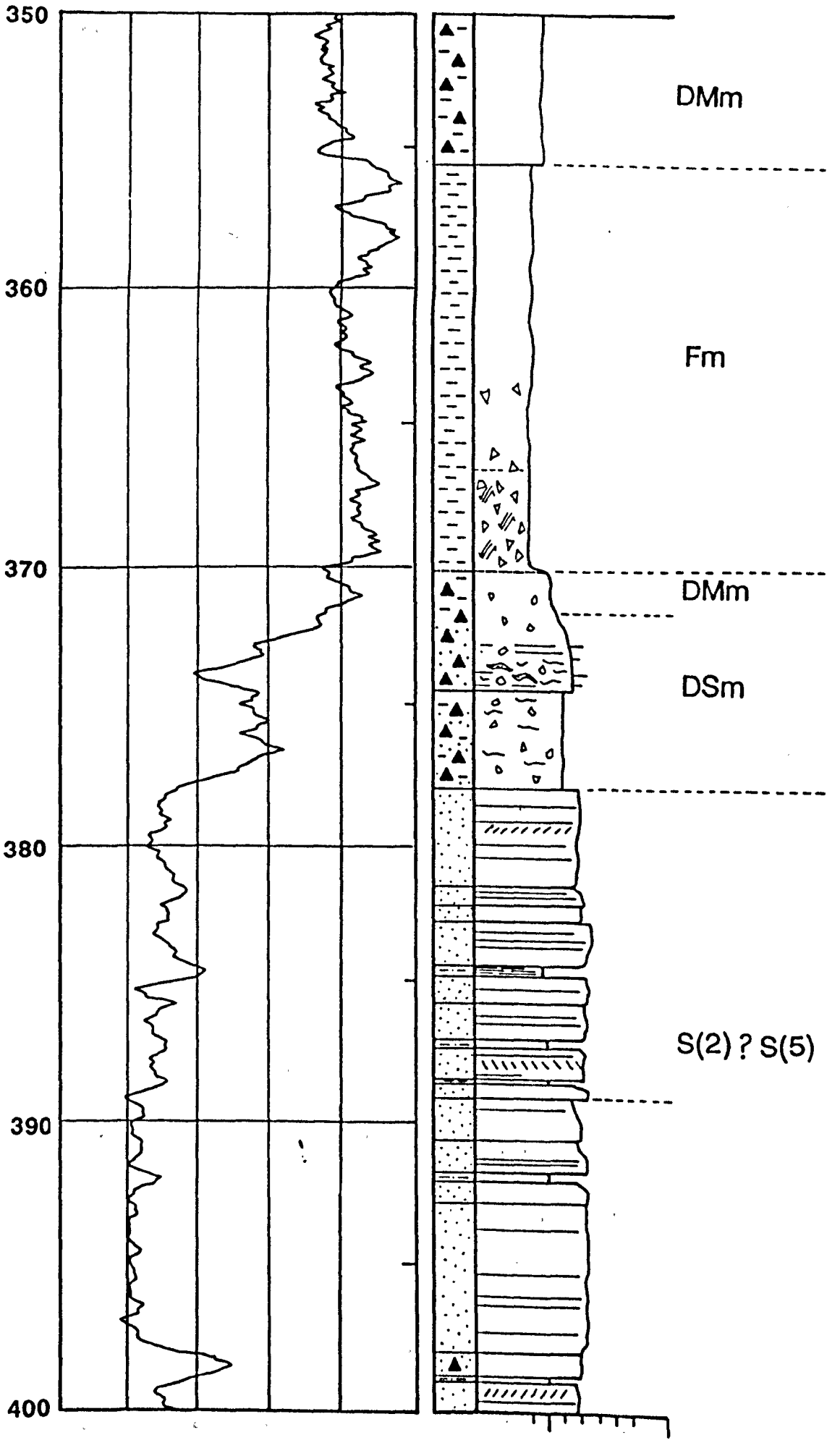

GAMMA RAY
0
200
220
230
240
250
260
270
M
DMm
DMs
FI
S(6)
S(4)
DSs
S(6)

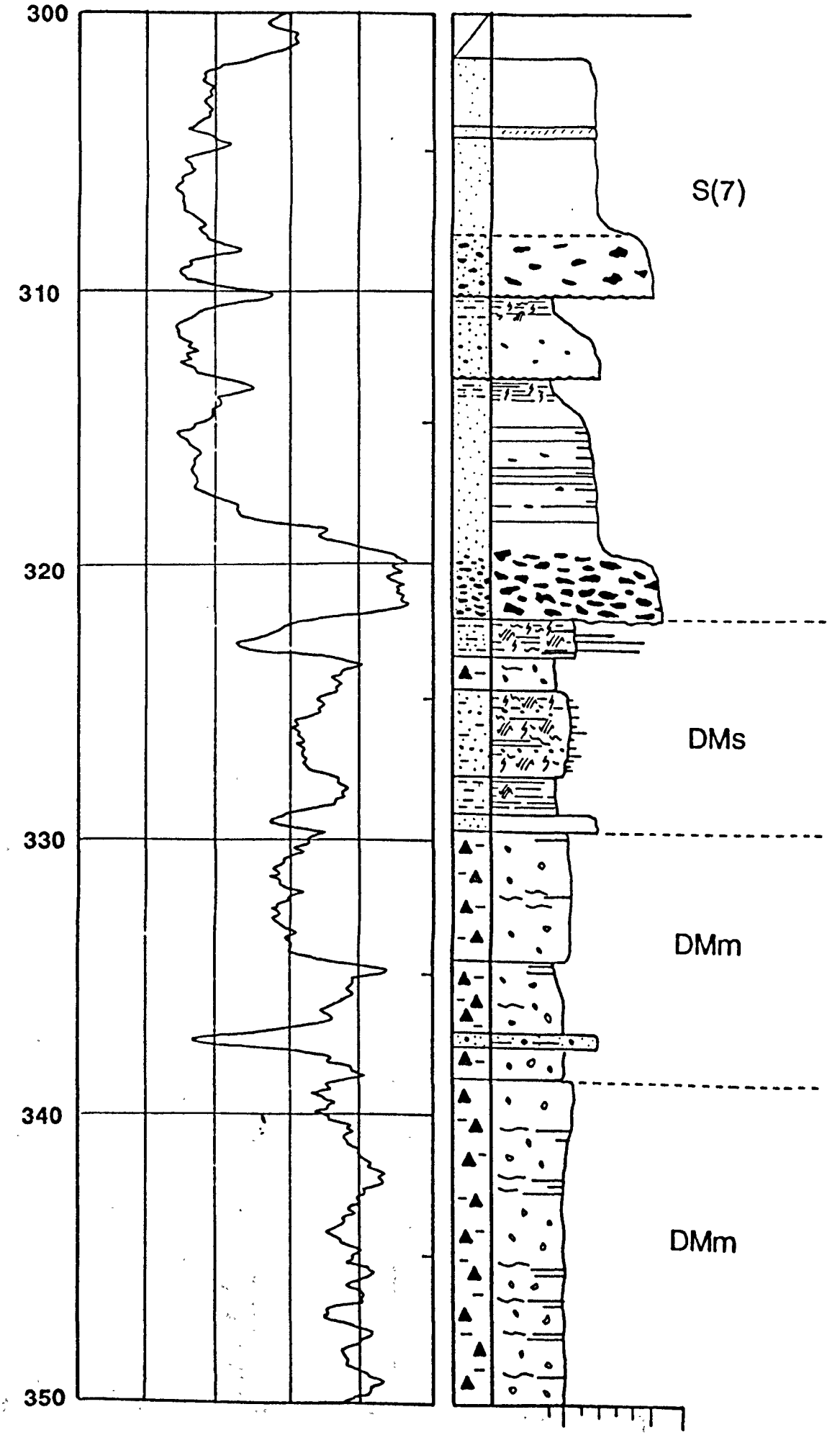

GAMMA RAY
0
200
170
180
190
200
210
220
M

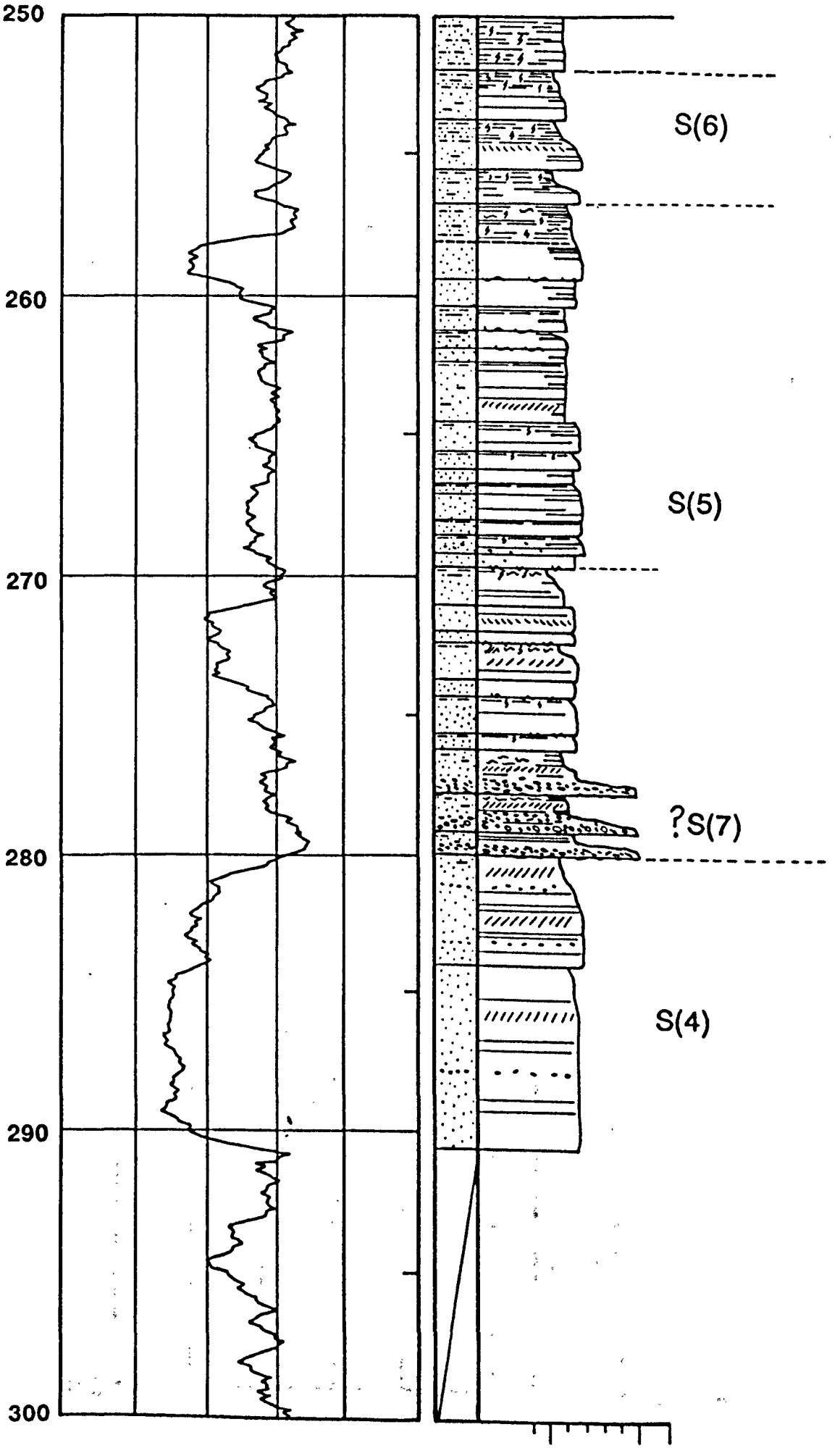

GAMMA RAY
0
200
120
130
140
150
160
170
H
M

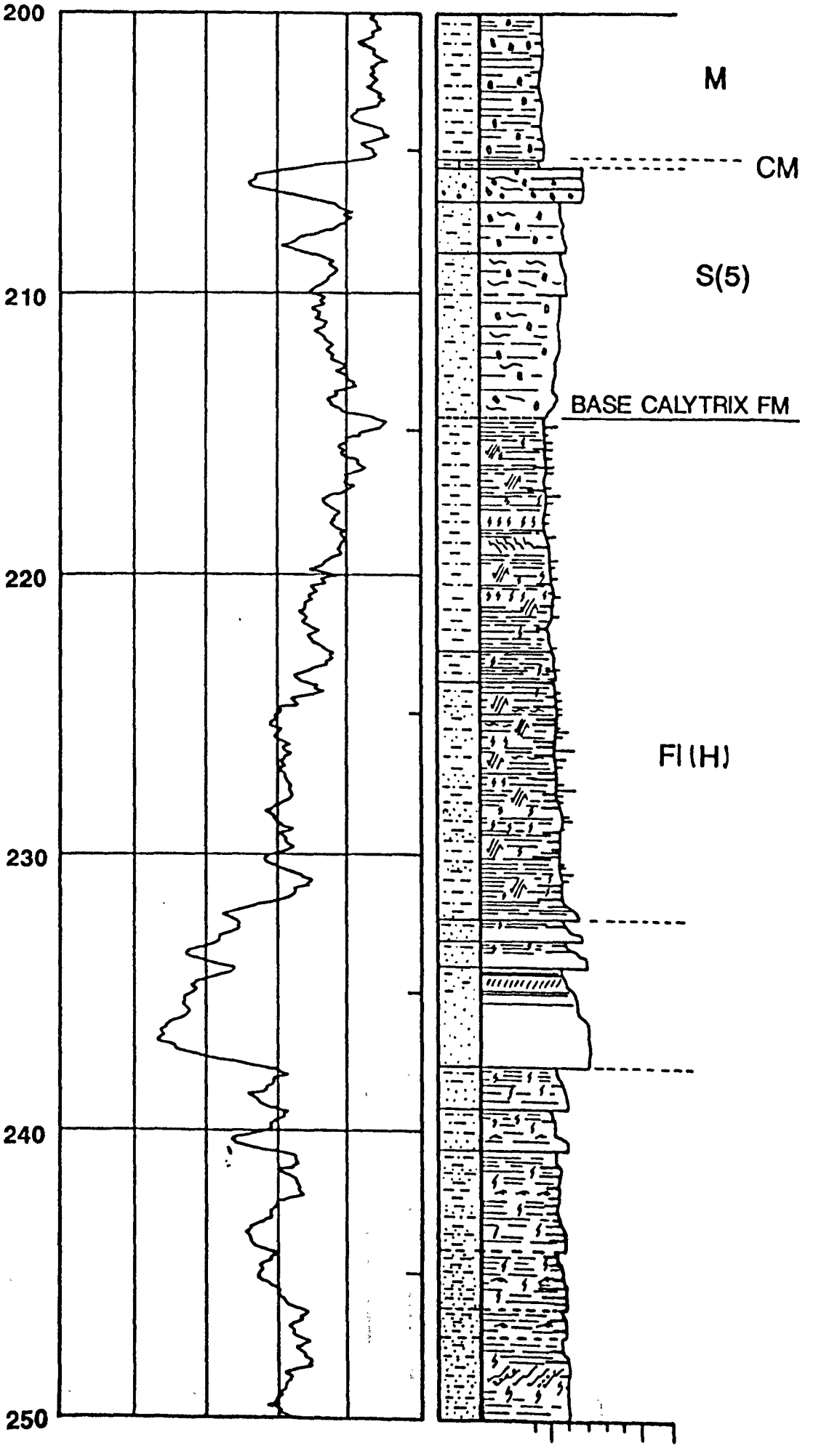
HOYA 1

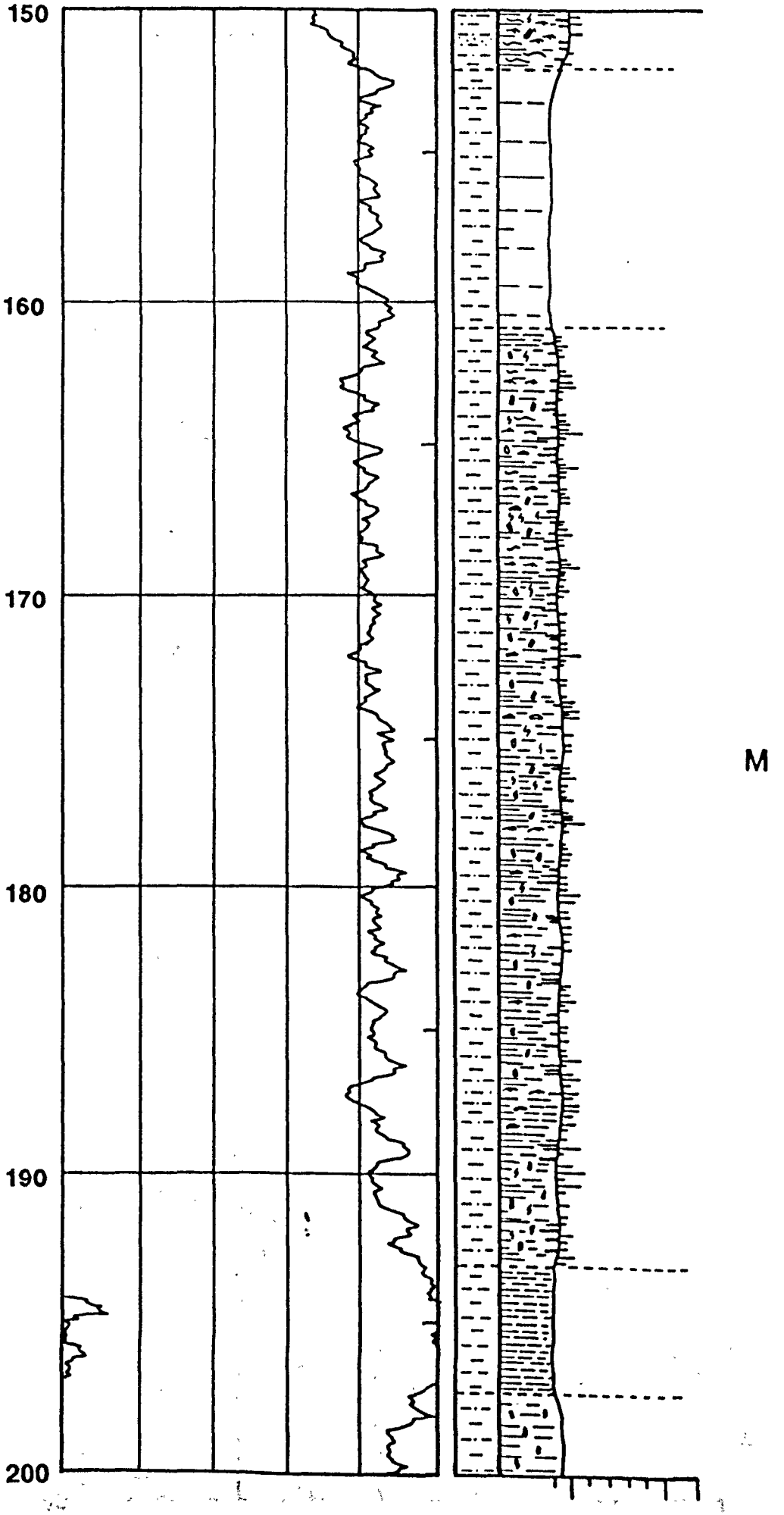

400
410
420
430
440
450
DSs
DSm
BD
BASE GRANT
UNCONFORMITY

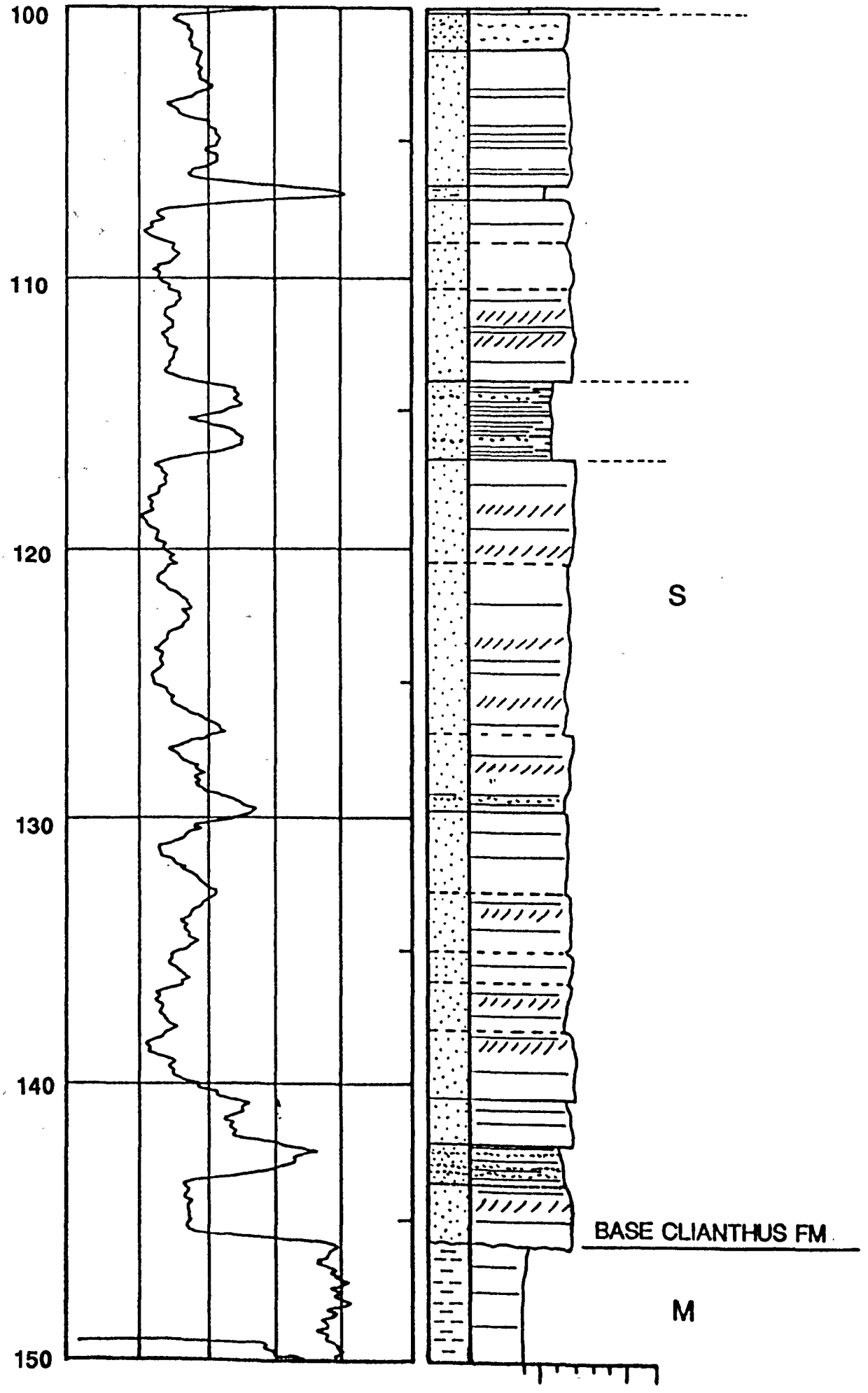

350
360
370
380
390
400
DMm
Fm
DMm
DSm
S(2) ? S(5)

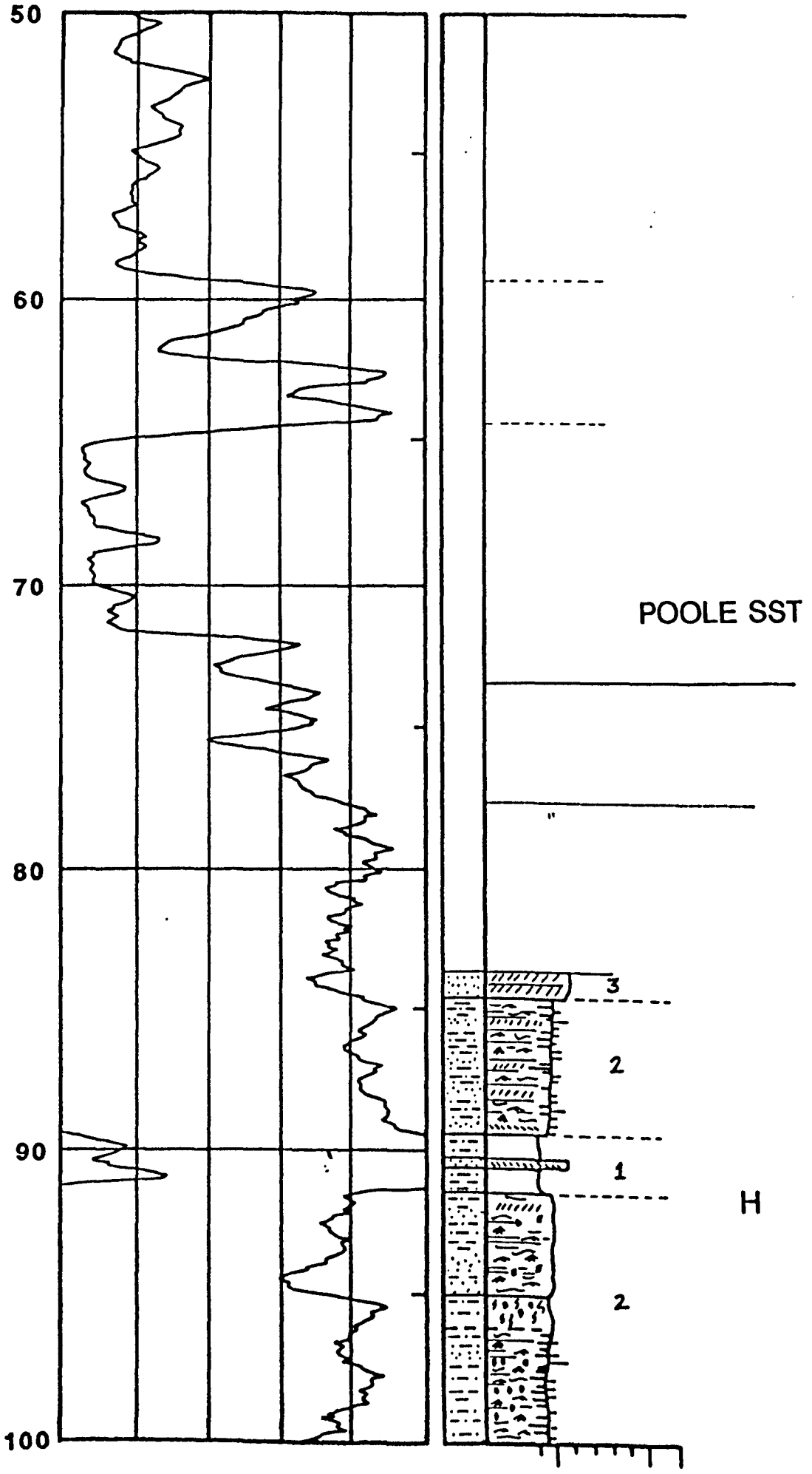

300
310
320
330
340
350
S(7)
DMs
DMm
DMm


250
260
270
280
290
300
S(6)
S(5)
?S(7)
S(4)

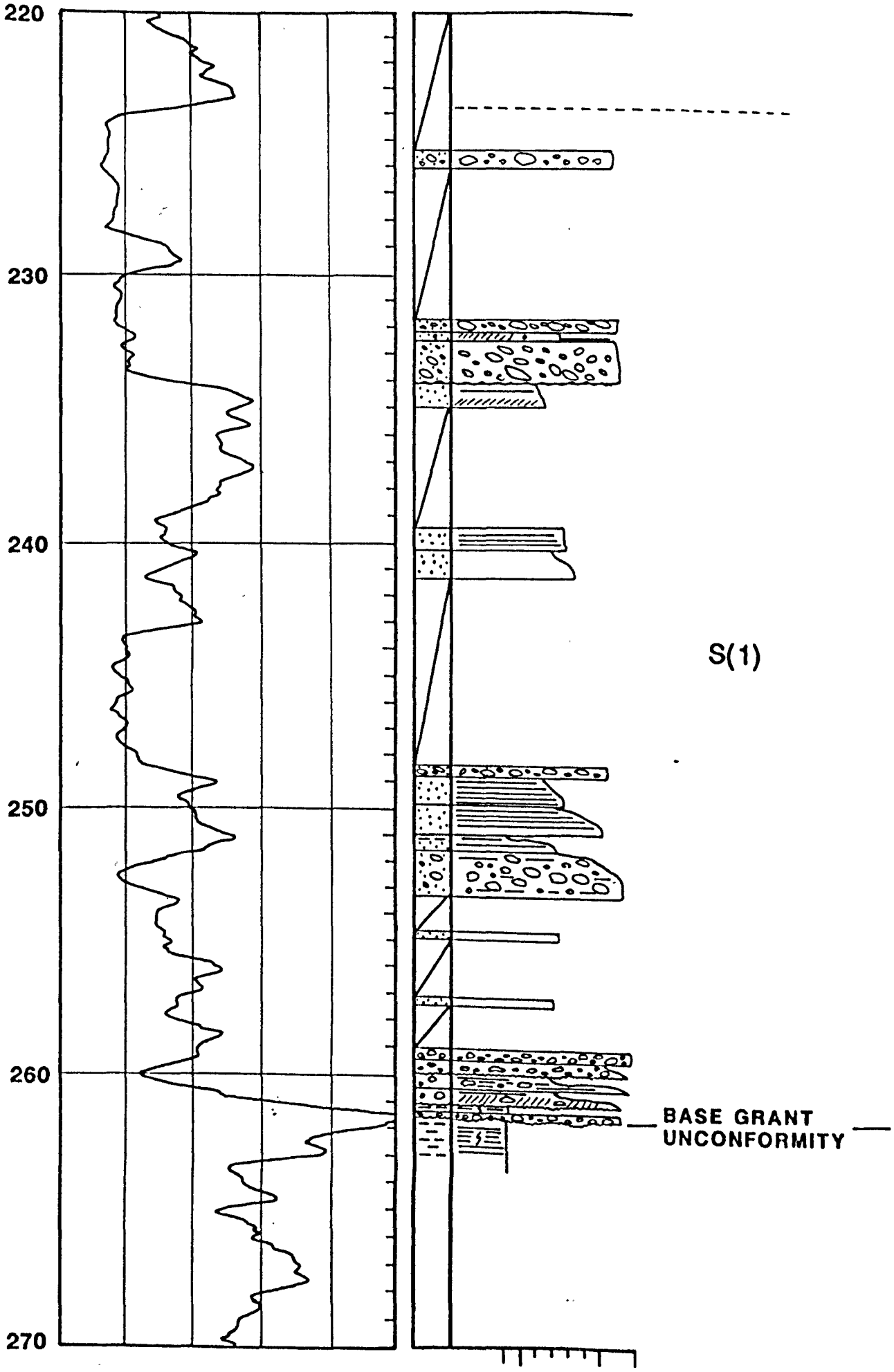

200
210
220
230
240
250
M
CM
S(5)
BASE CALYTRIX FM
FI(H)

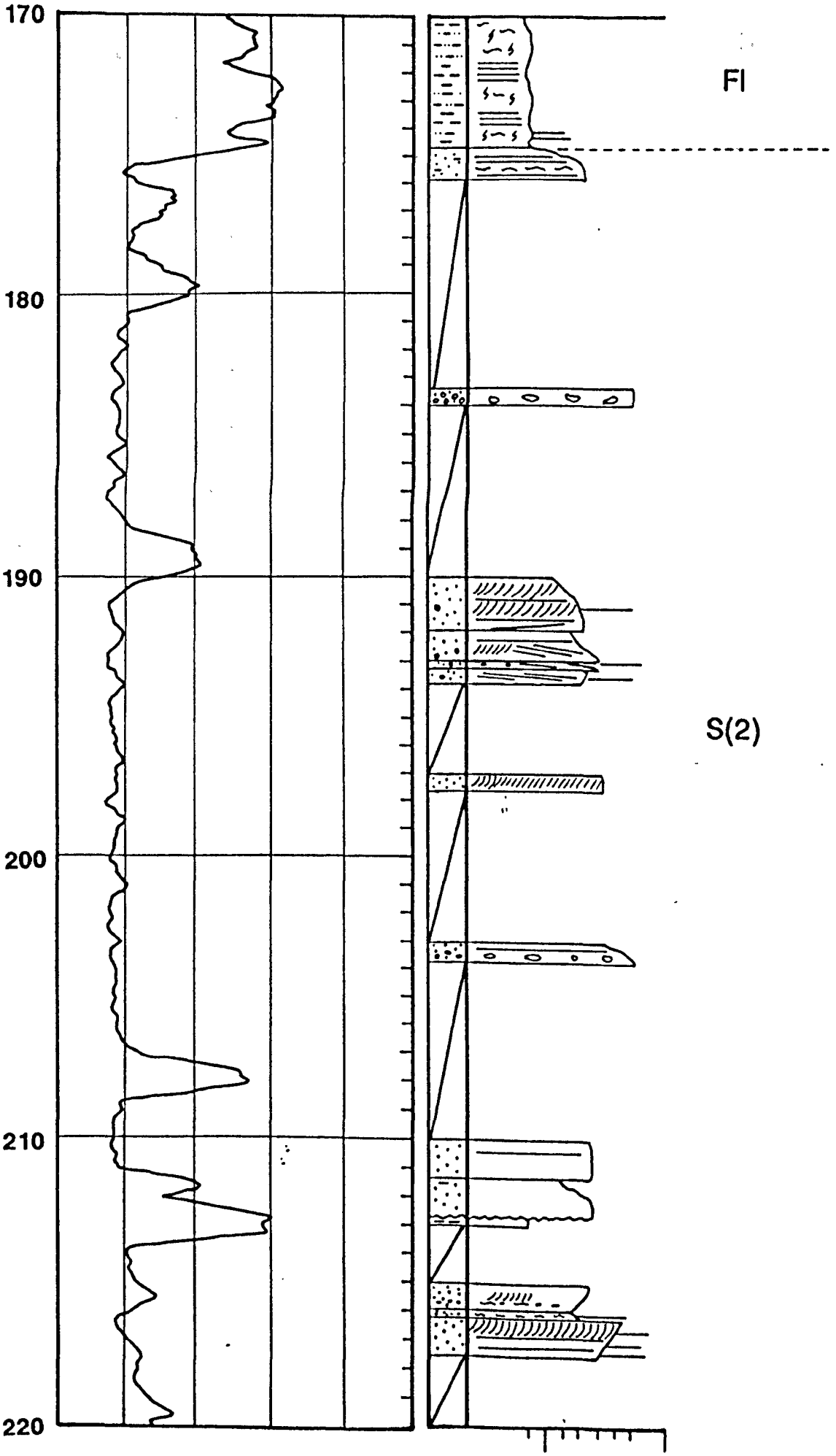

150
160
170
180
190
200
M

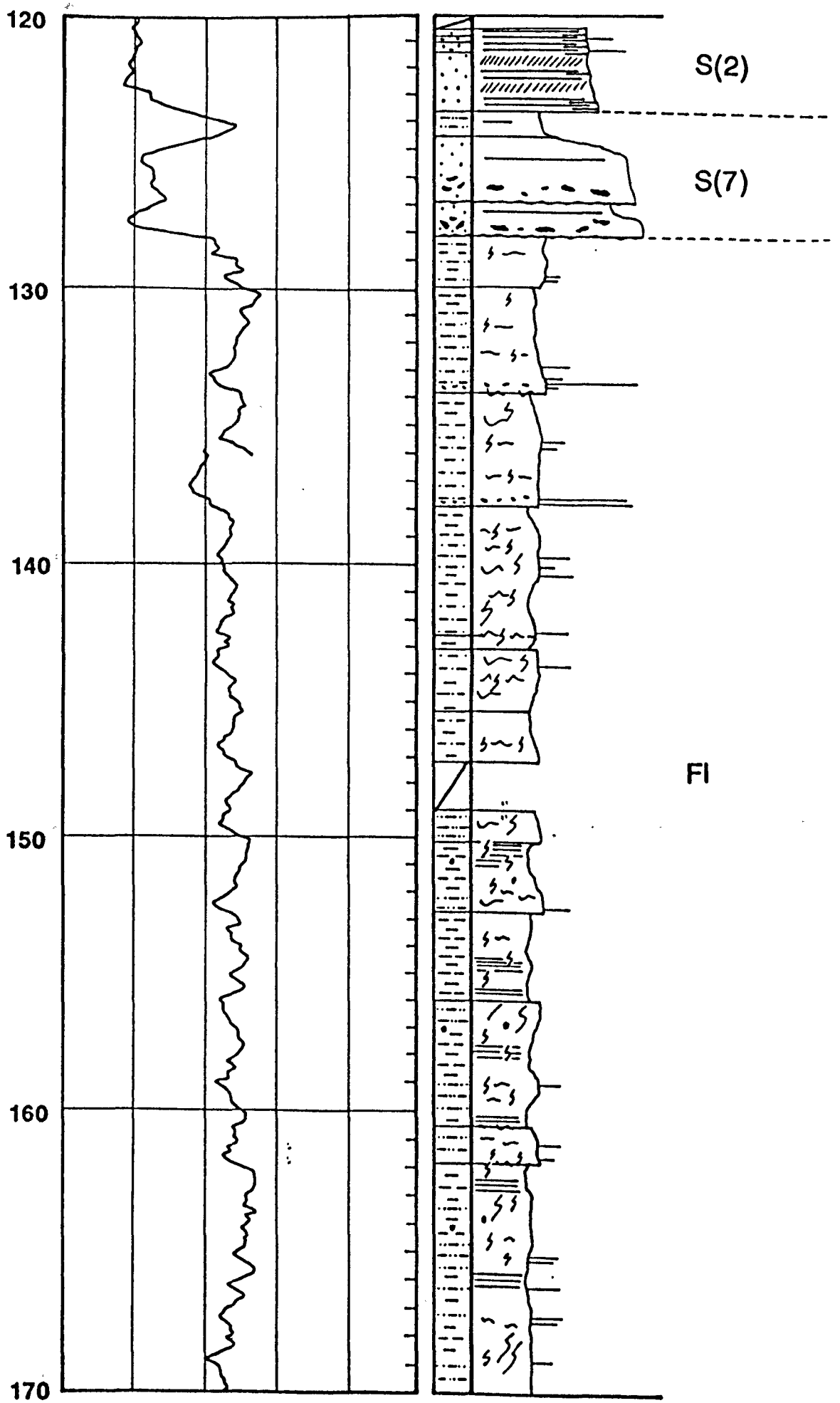

100
110
120
130
140
150
S
BASE CLIANTHUS FM
M

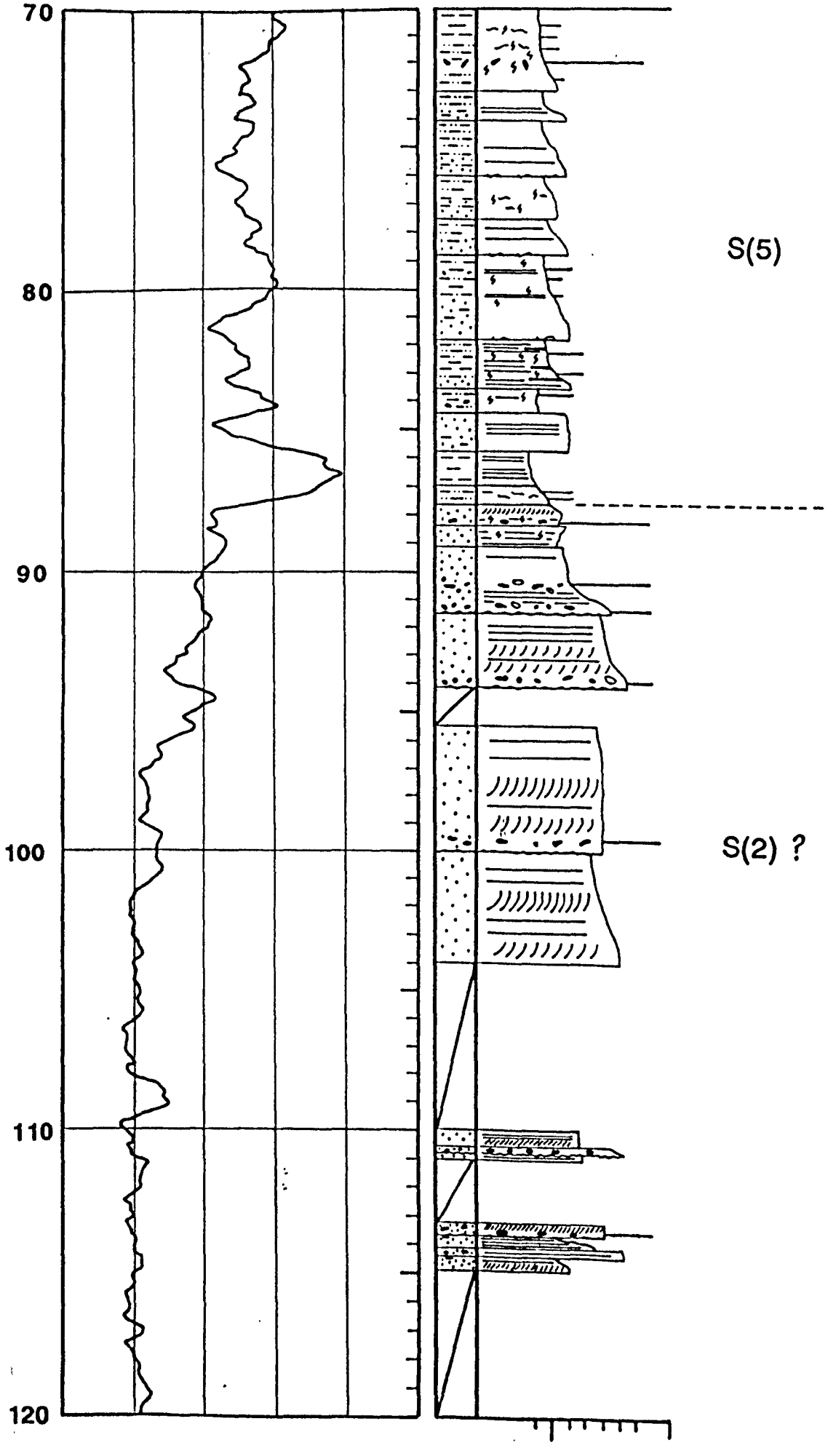

50
60
70
80
90
100
POOLE SST
3
2
1
2
H

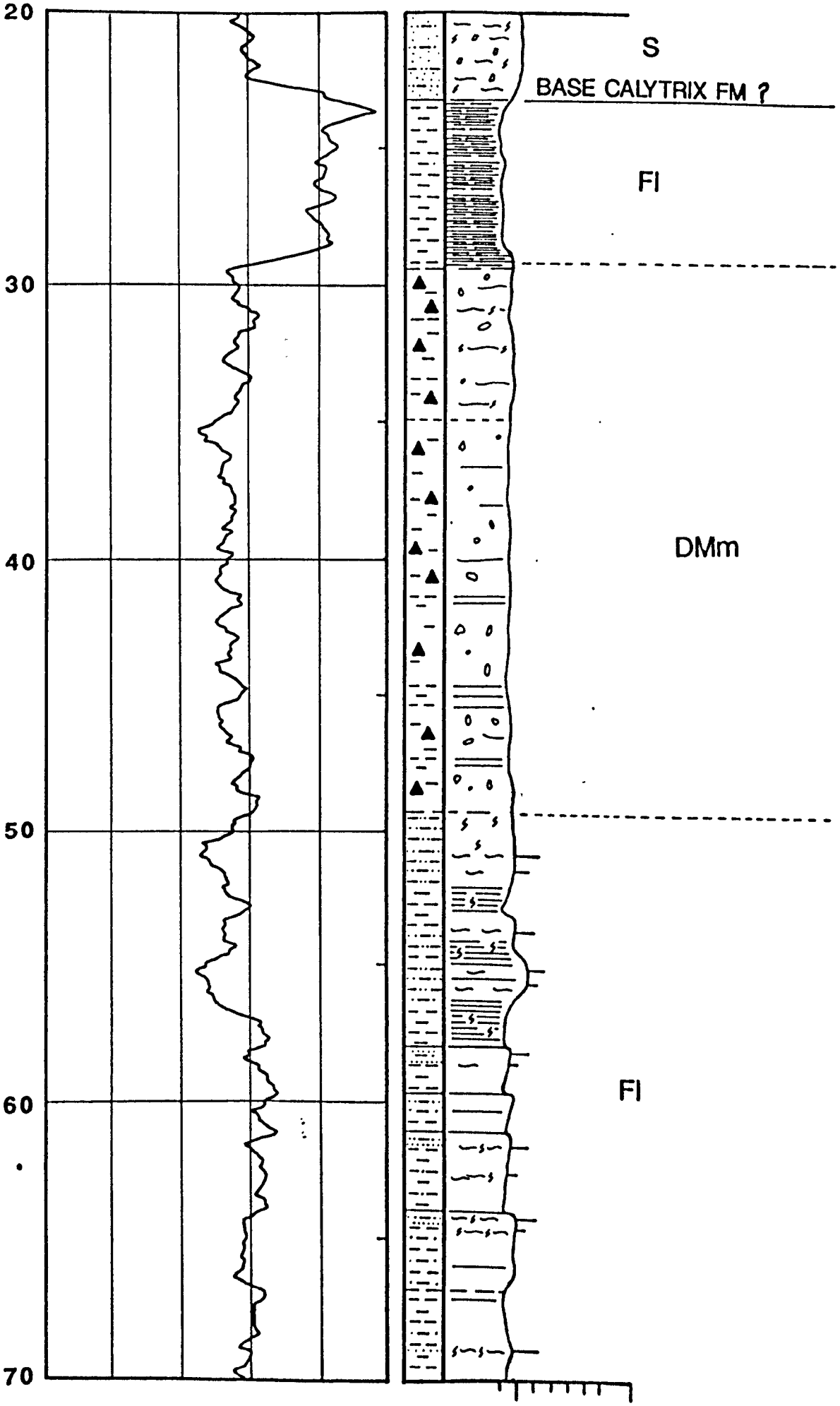
KUNZEA 1


220
230
240
250
260
270
S(1)
BASE GRANT
UNCONFORMITY

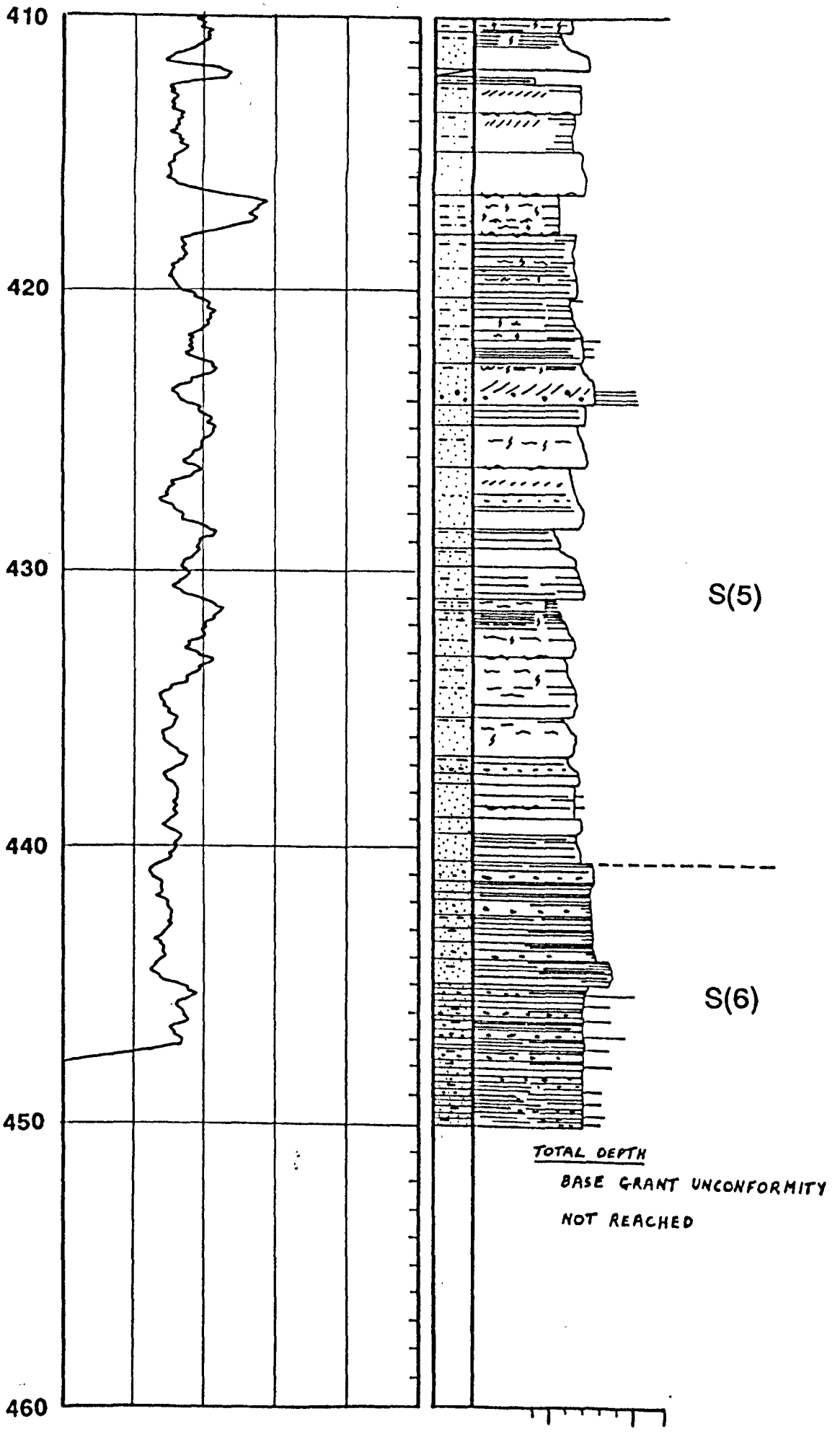

170
180
190
200
210
220
Fl
S(2)

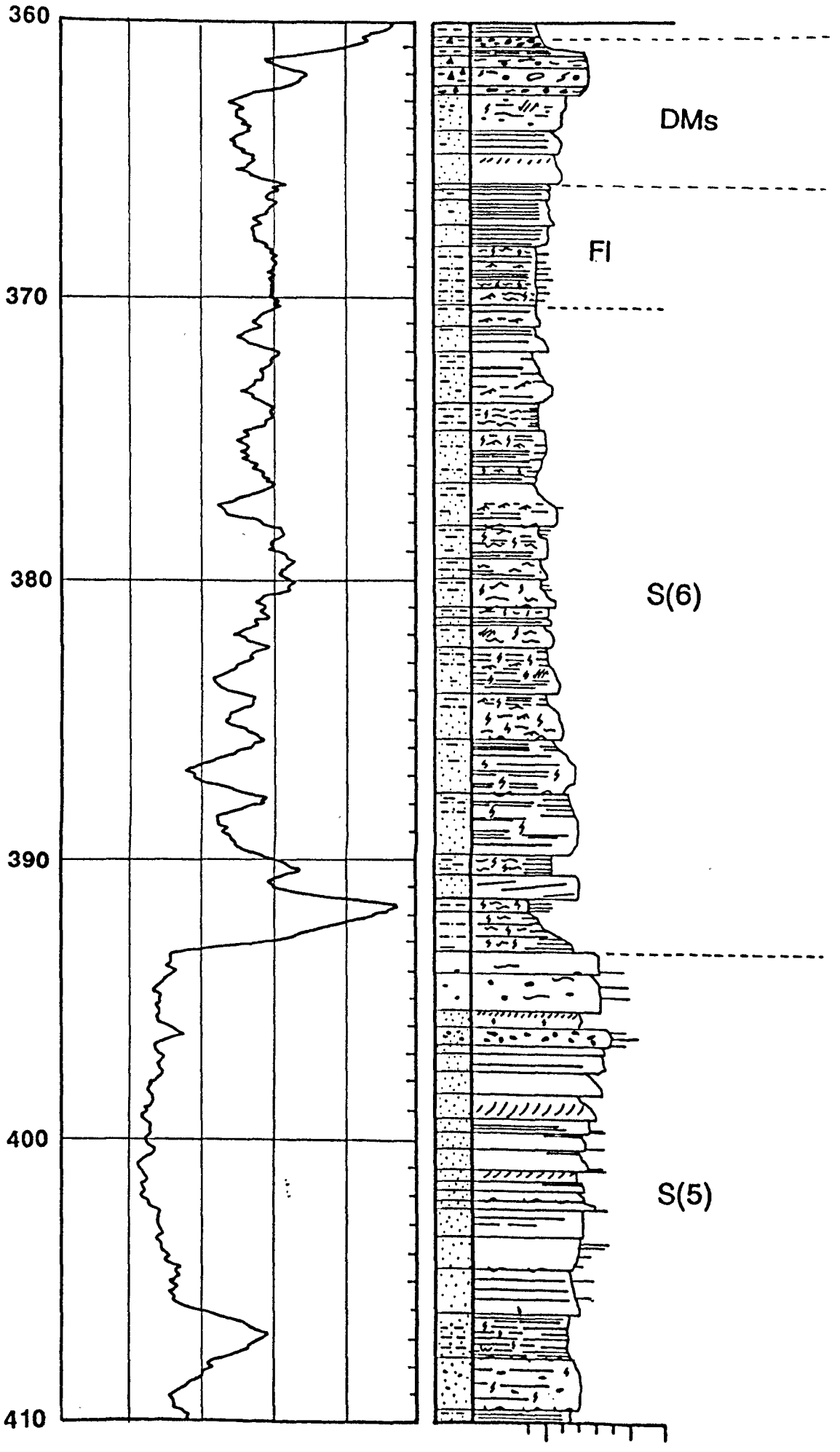

120
130
140
150
160
170
S(2)
S(7)
FI

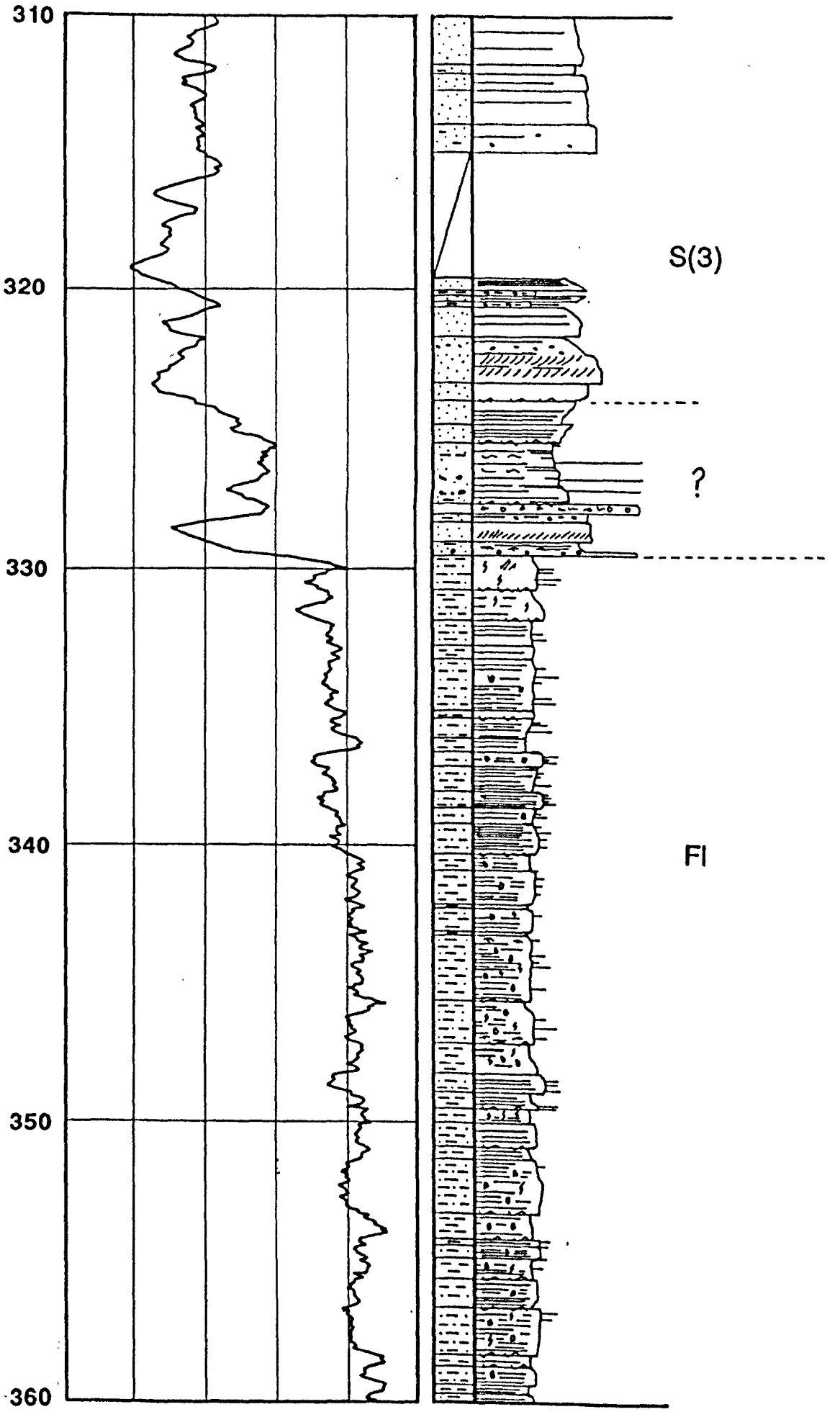

70
80
90
100
110
120
S(5)
S(2) ?

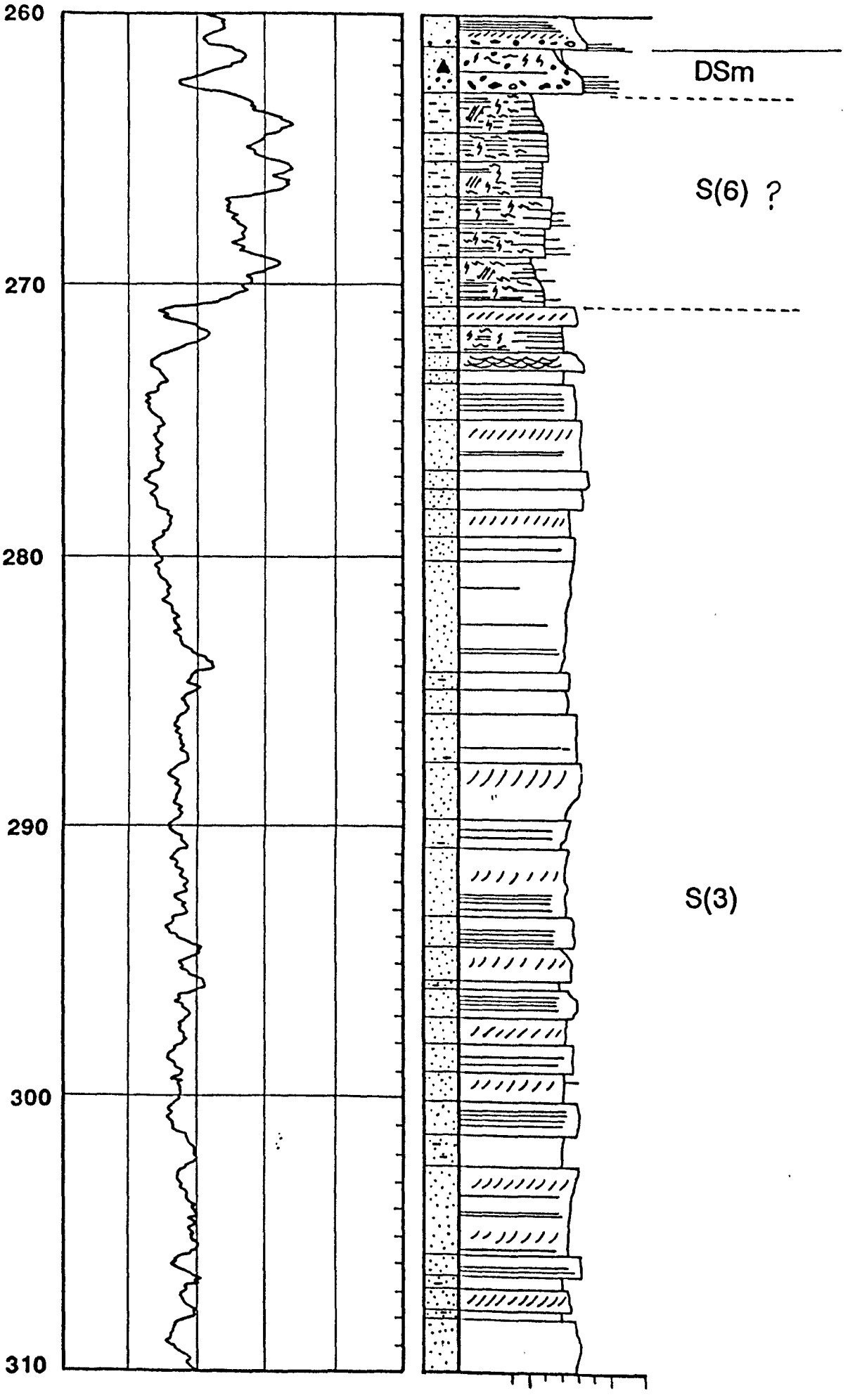

20
30
40
50
60
70
S
BASE CALYTRIX FM ?
Fl
DMm
Fl

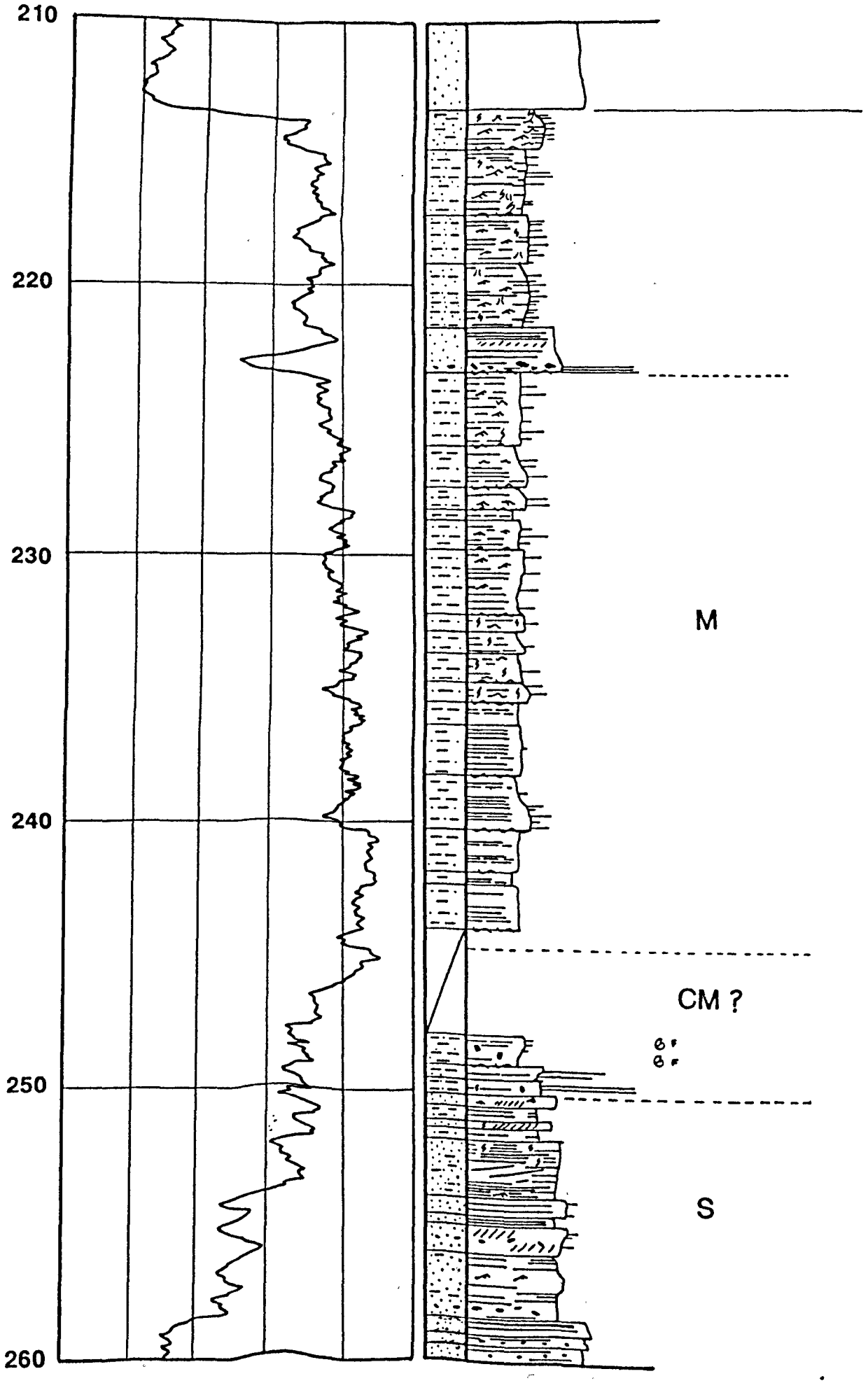
MELALEUCA 1

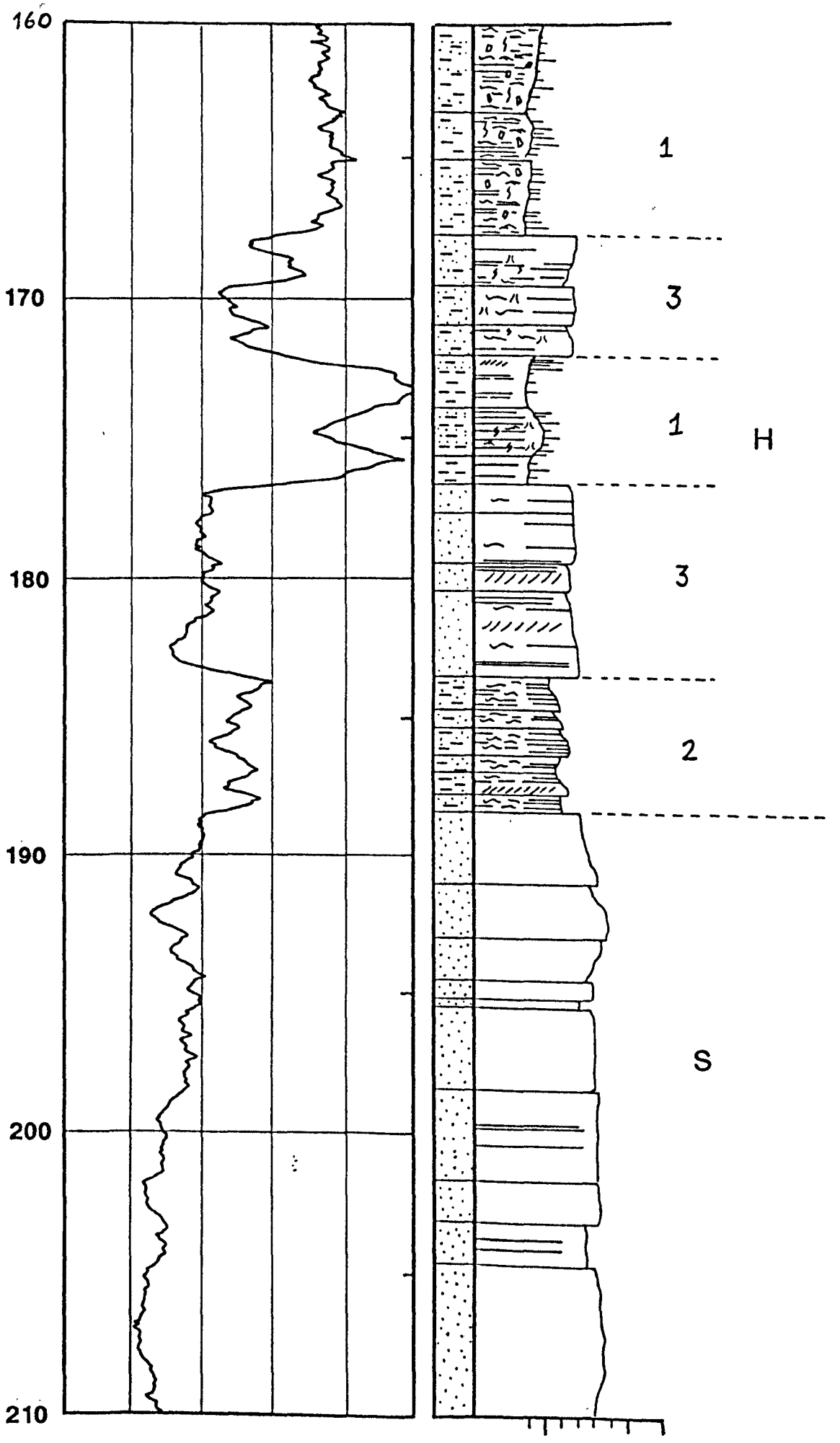

410
420
430
440
450
460
S(5)
S(6)
TOTAL DEPTH
BASE GRANT UNCONFORMITY
NOT REACHED

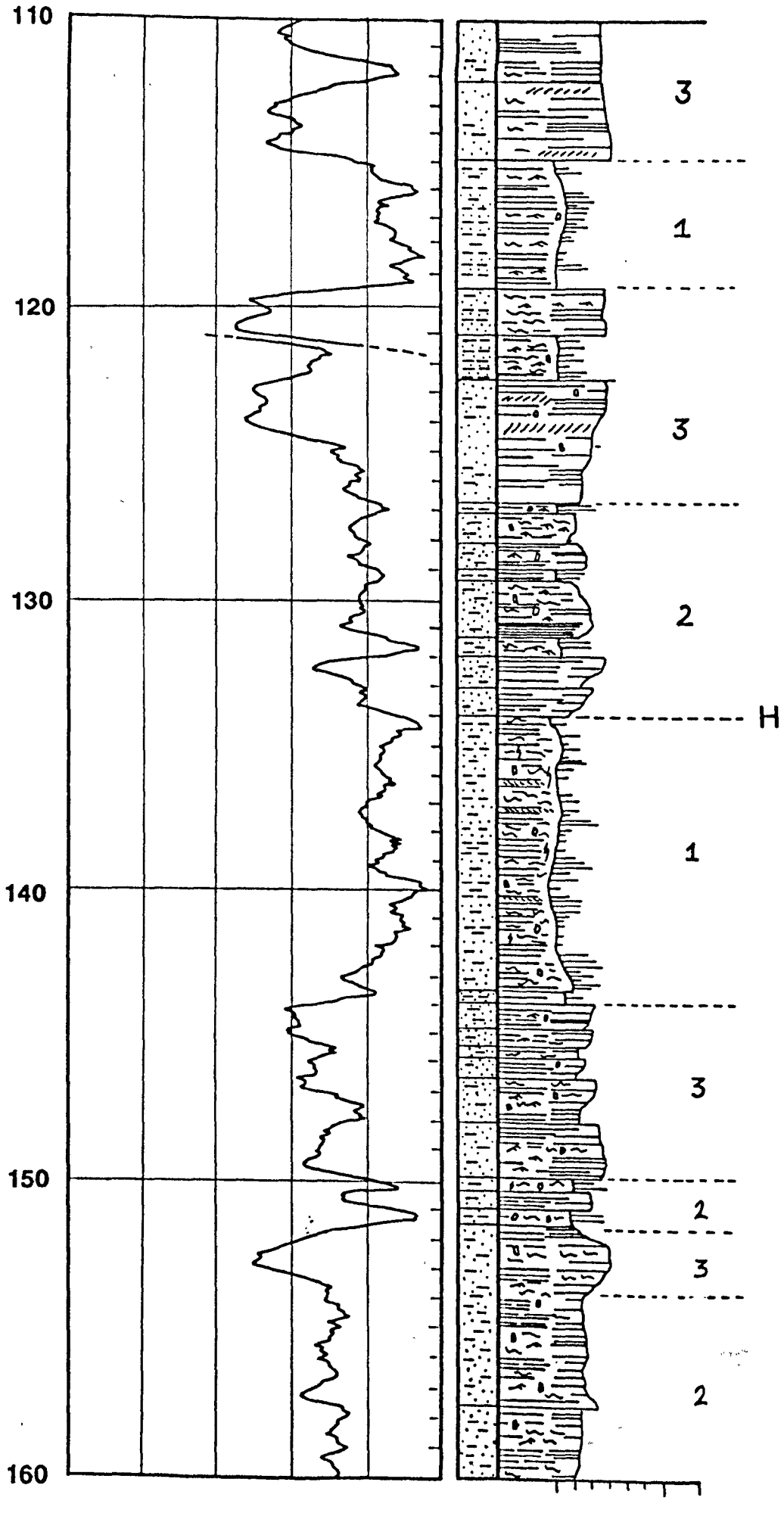

360
370
380
390
400
410
DMs
FI
S(6)
S(5)

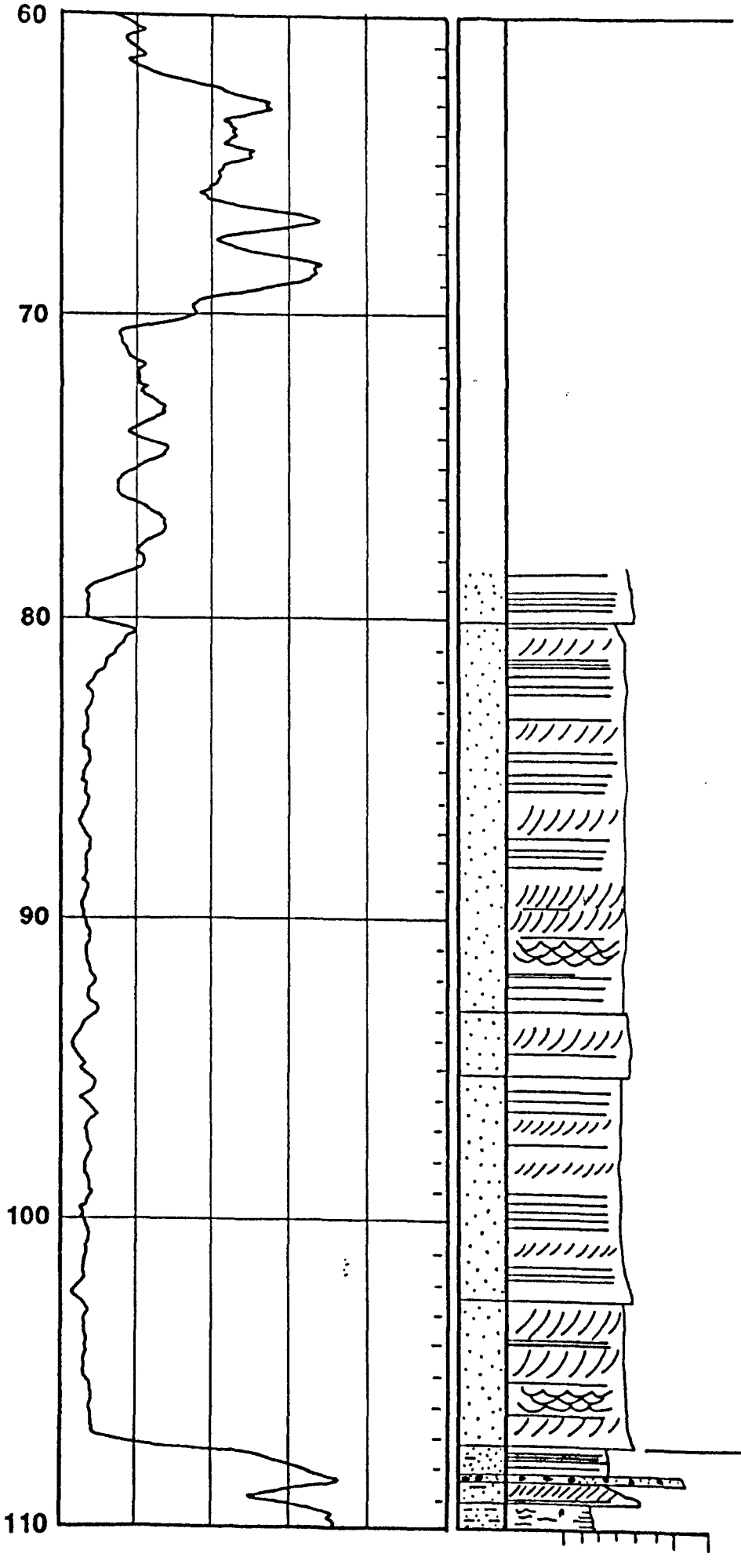

310
320
330
340
350
360
S(3)
?
Fl


260
270
280
290
300
310
DSm
S(6) ?
S(3)

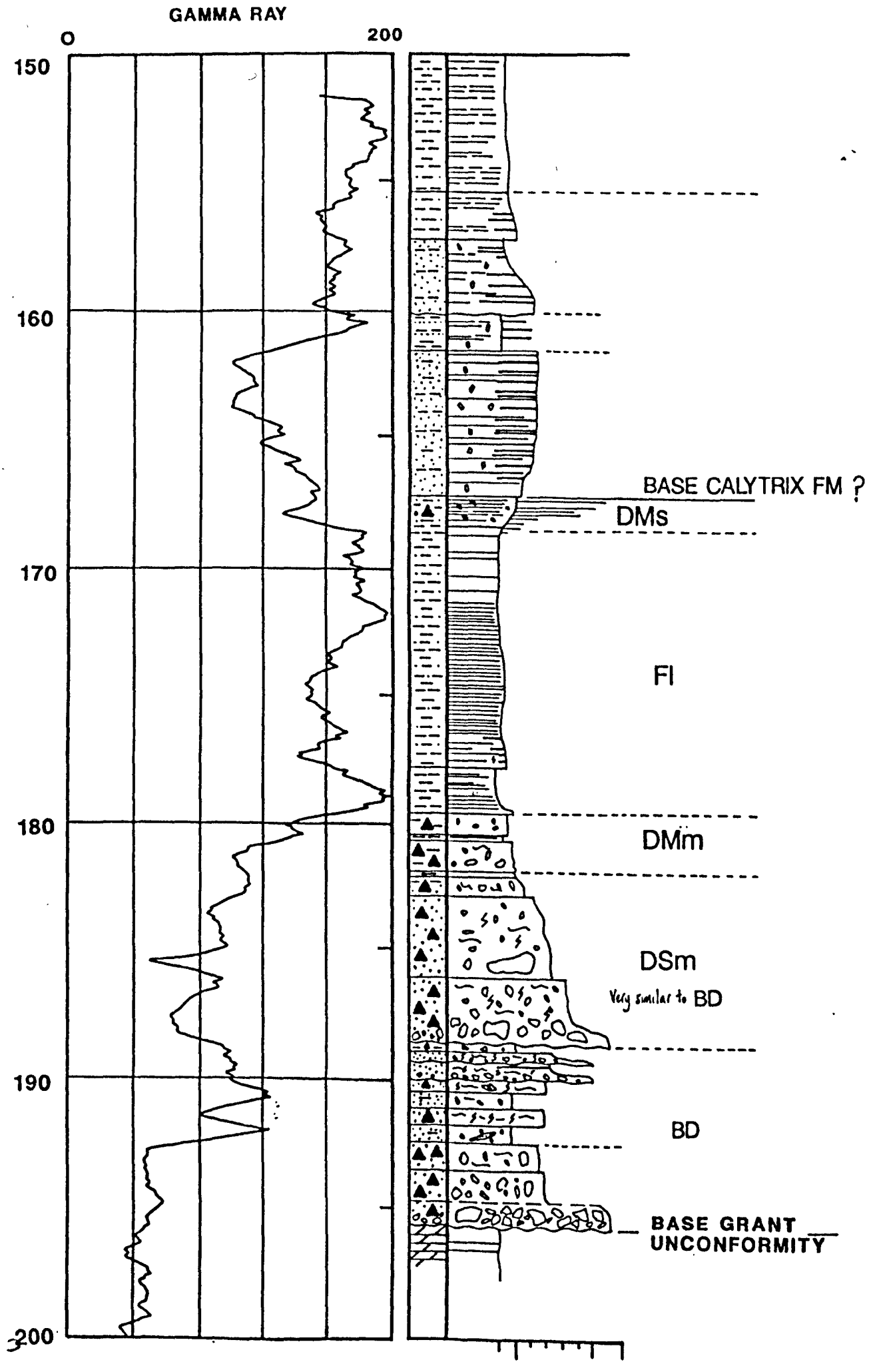

210
220
230
240
250
260
M
CM ?
S


160
170
180
190
200
210
1
3
1
H
3
2
S


110
120
130
140
150
160
3
1
3
2
H
1
3
2
3
2


60
70
80
90
100
110
POOLE SST

TRIODIA 1


GAMMA RAY
0
200
150
160
170
180
190
200
BASE CALYTRIX FM ?
DMs
FI
DMm
DSm
Very similar to BD
BD
BASE GRANT
UNCONFORMITY

APPENDIX 2

WELL NAME	ARISTIDA 1	LOCATION	Lat. 19 53' 55"S Long 125 19' 36"E
SPUD DATE	18 . 10 . 83	SEISMIC	Line 82-23B SP 602
ELEV.	177m	TD.	216m	CORED INTERVAL	112 - 216m

BASE GRANT	206.00m	TWT	N / A
TOP GRANT	?	SUBCROP	Nullara Lmst Equiv
THICKNESS	102m+	CORE METERAGE	

BASE HOYA FM	206.00m	NET SANDSTONE	0m
TOP HOYA FM	153.60m ?	NET / GROSS	N / A
THICKNESS	52.40m ?	NET DIAMICTITES	47.40m

BASE CALYTRIX	153.60m?	NET SANDSTONE	
TOP CALYTRIX		NET / GROSS	
THICKNESS			

BASE CLIANTHUS		NET SANDSTONE	
TOP CLIANTHUS		NET / GROSS	
THICKNESS			

WELL NAME	ARISTIDA 1A	LOCATION	Lat. 19 53' 55"S Long 125 19' 36"E
SPUD DATE	28. 10. 83	SEISMIC	Line 82-23B SP 602
ELEV.	177m ASL	TD.	734m	CORED INTERVAL	154 -734m

BASE GRANT	205.15m	TWT	
TOP GRANT	?	SUBCROP	NULLARA LMST EQUIV
THICKNESS	70m +	CORE METERAGE	

BASE HOYA FM	205.15m	NET SANDSTONE	1m
TOP HOYA FM	151.40m?	NET / GROSS	1 : 154
THICKNESS	53.75m	NET DIAMICTITES	44.95m

BASE CALYTRIX	151.40m?	NET SANDSTONE	
TOP CALYTRIX	145.20m?	NET / GROSS	
THICKNESS	6.2m		

BASE CLIANTHUS	145.20m?	NET SANDSTONE	
TOP CLIANTHUS		NET / GROSS	
THICKNESS			

WELL NAME	CALADENIA 1	LOCATION	Lat. 19 40' 46" Long. 125 06' 26"
SPUD DATE	5 . 9 . 83	SEISMIC	Line 82-24 SP 322
ELEV.	170m ASL	TD.	296.5m
CORED INTERVAL	80 - 296.5m		

BASE GRANT	139.18m	TWT	Base 126ms
TOP GRANT	NR	SUBCROP	Nullara Lmst Equiv
THICKNESS	139.18m +	CORE METERAGE	59.18m

BASE HOYA FM	139.18m	NET SANDSTONE	1m
TOP HOYA FM	109.55m	NET / GROSS	1 : 30
THICKNESS	29.63m	NET DIAMICTITES	20m

BASE CALYTRIX	109.55m	NET SANDSTONE	
TOP CALYTRIX	35.80m	NET / GROSS	
THICKNESS	73.75m		

BASE CLIANTHUS	35.80m	NET SANDSTONE	35.80m
TOP CLIANTHUS		NET / GROSS	1 : 1
THICKNESS			

WELL NAME	CALYTRIX 1	LOCATION	Lat. 20 21' 22.3"S Long. 126 05' 17.5"E
SPUD DATE	29 . 4 . 84	SEISMIC	Line 84-41 SP 838
ELEV.	283m ASL	TD.	450m
CORED INTERVAL	84.5 - 450m		

BASE GRANT	396m	TWT	Base 199ms
TOP GRANT	78m	SUBCROP	Nullara Lmst Equiv
THICKNESS	318m	CORE METERAGE	311.50m

BASE HOYA FM	396m	NET SANDSTONE	25.60m
TOP HOYA FM	222m	NET / GROSS	1 : 7
THICKNESS	174m	NET DIAMICTITES	62m

BASE CALYTRIX	222m	NET SANDSTONE	
TOP CALYTRIX	143.50m	NET / GROSS	
THICKNESS	78.50m		

BASE CLIANTHUS	143.50m	NET SANDSTONE	32.50
TOP CLIANTHUS	78m	NET / GROSS	1 : 2
THICKNESS	65.5m		

WELL NAME	CLIANTHUS 1	LOCATION	Lat. 20 18' 16.6"S Long. 126 05' 19.7"E		
SPUD DATE	14 . 5 . 84	SEISMIC	Line 84-41 SP 1381		
ELEV.	258M ASL	TD.	450m	CORED INTERVAL	112 - 450m

BASE GRANT	NR 450m+	TWT	Base 277ms+ Top 70ms
TOP GRANT	148.50m	SUBCROP	NR Nullara Lmst Equiv
THICKNESS	301.5m +	CORE METERAGE	301.5m

BASE HOYA FM	NR 450m +	NET SANDSTONE	13.50m
TOP HOYA FM	324m	NET / GROSS	1 : 9
THICKNESS	126m	NET DIAMICTITES	30m +

BASE CALYTRIX	324m	NET SANDSTONE	
TOP CALYTRIX	224m	NET / GROSS	
THICKNESS	100m		

BASE CLIANTHUS	224m	NET SANDSTONE	38.50m
TOP CLIANTHUS	148.50m	NET / GROSS	1 : 2
THICKNESS	75.5m		

WELL NAME	DROSERA 1	LOCATION	Lat. 19 40' 46"S Long. 125 02' 22"E
SPUD DATE	30 . 3 . 84	SEISMIC	Line 82-24 SP 144
ELEV.	165m ASL	TD.	450m
CORED INTERVAL	46-450m		

BASE GRANT	440.55m	TWT	Base 351ms Top 93ms
TOP GRANT	? 60m	SUBCROP	Carrlbuddy Fm
THICKNESS	380.55m +	CORE METERAGE	380.55m

BASE HOYA FM	440.55m	NET SANDSTONE	271.35m
TOP HOYA FM		NET / GROSS	1 : 1.4
THICKNESS	380.55m+	NET DIAMICTITES	14m

BASE CALYTRIX		NET SANDSTONE	
TOP CALYTRIX		NET / GROSS	
THICKNESS			

BASE CLIANTHUS		NET SANDSTONE	
TOP CLIANTHUS		NET / GROSS	
THICKNESS			

WELL NAME	EREMOPHILA 1	LOCATION	Lat. 19 46' 49.985"S Long. 125 12' 12.710"
SPUD DATE	6 . 4 . 82	SEISMIC	Line 82-20A SP
ELEV.	173.60 ASL	TD.	1252m
CORED INTERVAL	115.6-1252m		

BASE GRANT	195.60m	TWT	
TOP GRANT	43m ?	SUBCROP	Nullara Lmst Equlv.
THICKNESS	152.60m	CORE METERAGE	80m

BASE HOYA FM	195.60m	NET SANDSTONE	
TOP HOYA FM	174.30m	NET / GROSS	
THICKNESS	21.30m	NET DIAMICTITES	5m

BASE CALYTRIX	174.30m	NET SANDSTONE	
TOP CALYTRIX	97m ?	NET / GROSS	
THICKNESS	77.30m ?		

BASE CLIANTHUS	97m?	NET SANDSTONE	40m
TOP CLIANTHUS	43m?	NET / GROSS	1 : 1.35
THICKNESS	54m?		

WELL NAME	EREMOPHILA 2	LOCATION	Lat. 19 46' 49" S Long. 125 13' 05"E
SPUD DATE	1 . 12 . 83	SEISMIC	Line 82 - 20A SP 655
ELEV.	173m ASL	TD.	360m
CORED INTERVAL	91 - 360m		

BASE GRANT	228.16m	TWT	Base 232ms
TOP GRANT	33m?	SUBCROP	Nullara Lmst Equiv
THICKNESS	195.16m	CORE METERAGE	173.16m

BASE HOYA FM	228.16m	NET SANDSTONE	
TOP HOYA FM	177m	NET / GROSS	
THICKNESS	51.16m	NET DIAMICTITES	36.50m

BASE CALYTRIX	177m	NET SANDSTONE	
TOP CALYTRIX	85m	NET / GROSS	
THICKNESS	92m		

BASE CLIANTHUS	85m	NET SANDSTONE	40m
TOP CLIANTHUS	33m ?	NET / GROSS	1 : 1.3
THICKNESS	52m?		

WELL NAME	EREMOPHILA 3	LOCATION	Lat. 19 46' 46"S Long. 125 14' 13"E
SPUD DATE	7 . 12 . 83	SEISMIC	Line 82-20A SP 705
ELEV.	176m	TD.	464m
CORED INTERVAL	75 - 464m		

BASE GRANT	295m	TWT	Base 276ms
TOP GRANT	19m ?	SUBCROP	Nullara Lmst Equiv
THICKNESS	276m ?	CORE METERAGE	219m

BASE HOYA FM	295m	NET SANDSTONE	23m
TOP HOYA FM	193m	NET / GROSS	1 : 2.5
THICKNESS	102m	NET DIAMICTITES	38.50m

BASE CALYTRIX	193m	NET SANDSTONE	
TOP CALYTRIX	78.30m	NET / GROSS	
THICKNESS	114.70		

BASE CLIANTHUS	78.30	NET SANDSTONE	
TOP CLIANTHUS	19	NET / GROSS	
THICKNESS	59.30		

WELL NAME	FICUS 1	LOCATION	Lat. 19 49' 08"S Long. 125 17' 53"E
SPUD DATE	5 . 1 . 82	SEISMIC	Line 84 - 20 SP 1250
ELEV.	185m ASL	TD.	1083.7m
CORED INTERVAL	39-52 90-TD		

BASE GRANT	474.30m	TWT	Base 348ms
TOP GRANT	50m?	SUBCROP	Fairfield Fm
THICKNESS	424.30m	CORE METERAGE	384.30m

BASE HOYA FM	474.30m	NET SANDSTONE	99.50m
TOP HOYA FM	313.40m	NET / GROSS	1 : 1.6
THICKNESS	160.90m	NET DIAMICTITES	16m

BASE CALYTRIX	313.40m	NET SANDSTONE	
TOP CALYTRIX	171.20m	NET / GROSS	
THICKNESS	142.20m		

BASE CLIANTHUS	171.20m	NET SANDSTONE	
TOP CLIANTHUS	50m ?	NET / GROSS	
THICKNESS	121.20m		

WELL NAME	GOODENIA 1	LOCATION	Lat. 19 51' 52" S Long. 125 13' 44" E
SPUD DATE	21 . 11 . 83	SEISMIC	Line 82 - 49 SP 890
ELEV.	176m	TD.	464m
CORED INTERVAL	75 - 464m		

BASE GRANT	105.20m	TWT	Base 130ms
TOP GRANT	50m ?	SUBCROP	Nullara Lmst Equiv
THICKNESS	55.20m??	CORE METERAGE	5.20m

BASE HOYA FM	105.20m	NET SANDSTONE	
TOP HOYA FM	?	NET / GROSS	
THICKNESS	?	NET DIAMICTITES	

BASE CALYTRIX	?	NET SANDSTONE	
TOP CALYTRIX	?	NET / GROSS	
THICKNESS	?		

BASE CLIANTHUS		NET SANDSTONE	
TOP CLIANTHUS		NET / GROSS	
THICKNESS			

WELL NAME	HALGANIA 1	LOCATION	Lat. 19 41' 28"S Long 125 23' 44"E
SPUD DATE	17 . 8 . 83	SEISMIC	Line 82-24 SP 1079
ELEV.	200m ASL	TD.	500m
CORED INTERVAL	133 - 500m		

BASE GRANT	309.17m	TWT	Base 284ms Nr Top 38ms
TOP GRANT	26m	SUBCROP	Fairfield/Nullara Lmst
THICKNESS	283.17m	CORE METERAGE	176.17m

BASE HOYA FM	309.17m	NET SANDSTONE	32m
TOP HOYA FM	228.55m	NET / GROSS	1 : 2.5
THICKNESS	80.62m	NET DIAMICTITES	19m

BASE CALYTRIX	228.55m	NET SANDSTONE	4.5m
TOP CALYTRIX	104m ?	NET / GROSS	1 : 27.6
THICKNESS	124.55m		

BASE CLIANTHUS	104m ?	NET SANDSTONE	N / A
TOP CLIANTHUS	26m ?	NET / GROSS	N / A
THICKNESS	78m ?		

WELL NAME	HOYA 1	LOCATION	Lat. 20 23" 37.2"S Long. 126 05' 18.6"E
SPUD DATE	7 . 5 . 84	SEISMIC	Line 84 - 41 SP 450
ELEV.	285m ASL	TD.	450m
CORED INTERVAL	85 - 450m		

BASE GRANT	434.40m	TWT	Base 249ms Top -3ms
TOP GRANT	71.80m	SUBCROP	Nullara Lmst Equiv
THICKNESS	362.60	CORE METERAGE	362.60m

BASE HOYA FM	434.40m	NET SANDSTONE	26m
TOP HOYA FM	214.40m	NET / GROSS	1 : 8.5
THICKNESS	220m	NET DIAMICTITES	60m

BASE CALYTRIX	214.40m	NET SANDSTONE	
TOP CALYTRIX	145.50m	NET / GROSS	
THICKNESS	68.90m		

BASE CLIANTHUS	145.50m	NET SANDSTONE	41.50m
TOP CLIANTHUS	72m	NET / GROSS	1 : 1.77
THICKNESS	73.50m		

WELL NAME	KUNZEA 1	LOCATION	Lat. 19 32' 06.4"S Long. 124 59' 22.9"E		
SPUD DATE	27 . 5 . 84	SEISMIC	Line 83-1 SP 4551		
ELEV.	180m ASL	TD.	450m	CORED INTERVAL	8 - 450m

BASE GRANT	260.40m	TWT	Base 254ms Top 70ms
TOP GRANT	29.50m ?	SUBCROP	Carribuddy Fm
THICKNESS	230.90m	CORE METERAGE	230.90m

BASE HOYA FM	260.40m	NET SANDSTONE	116.5m
TOP HOYA FM	? 29.50m	NET / GROSS	1 : 2
THICKNESS	? 230.90m	NET DIAMICTITES	19.8m

BASE CALYTRIX		NET SANDSTONE	
TOP CALYTRIX		NET / GROSS	
THICKNESS			

BASE CLIANTHUS		NET SANDSTONE	
TOP CLIANTHUS		NET / GROSS	
THICKNESS			

WELL NAME	MELALEUCA	LOCATION	Lat. 19 41' 17.88"S Long. 125 32' 44.52"E
SPUD DATE	11 . 4 . 84	SEISMIC	Line 82-24 SP 1472
ELEV.	198m ASL	TD.	450m
CORED INTERVAL	78 - 450m		

BASE GRANT	450m +	TWT	Base 360ms Top 106ms
TOP GRANT	107.68m	SUBCROP	Not cored, Fairfield ?
THICKNESS	342.32m +	CORE METERAGE	372m

BASE HOYA FM	450m +	NET SANDSTONE	101.30m
TOP HOYA FM	261.66m	NET / GROSS	1 : 1.85
THICKNESS	188.34m+	NET DIAMICTITES	4.25m

BASE CALYTRIX	261.66m	NET SANDSTONE	0
TOP CALYTRIX	213.91m	NET / GROSS	
THICKNESS	47.75m		

BASE CLIANTHUS	213.91m	NET SANDSTONE	42.6m
TOP CLIANTHUS	107.68m	NET / GROSS	1 : 2.5
THICKNESS	106.23m		

WELL NAME	TRIODIA 1	LOCATION	Lat. 19 38' 17"S Long 125 13' 57"E
SPUD DATE	6 . 1 . 84	SEISMIC	Line 82 - 16 SP 750
ELEV.	178m	TD.	631m
CORED INTERVAL	139 - 631m		

BASE GRANT	195.60m	TWT	Base 192ms
TOP GRANT	NR	SUBCROP	Nullara Lmst Equiv
THICKNESS	195.60m+	CORE METERAGE	56m

BASE HOYA FM	195.60m	NET SANDSTONE	1.5m
TOP HOYA FM	167.25m	NET / GROSS	1 : 19
THICKNESS	28.35m	NET DIAMICTITES	28.35m

BASE CALYTRIX	167.25m	NET SANDSTONE	
TOP CALYTRIX	49m ?	NET / GROSS	
THICKNESS	118.25m?		

BASE CLIANTHUS	49m?	NET SANDSTONE	
TOP CLIANTHUS	At Surface	NET / GROSS	
THICKNESS	49m+?		

APPENDIX 3

MICROPALAEONTOLOGICAL EXAMINATION OF SAMPLES FROM WMC FICUS 1 AND EREMOPHILA 2

V. PALMIERI
Geological Survey of Queensland

FICUS 1 305.06 - 290.00m (7 samples)

Grey sandy mudstones (305-302m); grey mudstones to shales (varvate mud) (301-290m). Pyritic aggregates and pyritic replacement of organic matter (305-296m); hydrocarbon stain (305-302m); rounded quartz grains at 290m; calcite present (305-302m). Immature brachiopods (*Chonetes*) at 305 and 302.9m; gastropods (*Warthia*) at 302.9m, and (*Paraplatyschisma*) at 296m.

Agglutinating foraminifers throughout. The fauna is characterised by textulariid and verneulinid foraminifers in a quite diverse assemblage, probably achieving its acme at 304m.

Within a periglacial marine environment it represents a small transgressive - regressive cycle. The environment is also, overall, a reducing one.

This is believed to be the first Permian transgressive episode of the region and can be correlated, on faunal basis and allowing for facies variation, to: Calytrix 1 220m (base of transgression?) to 199m (acme of marine episode, with relatively more temperate climate); Dampiera 1A at 295.4m (possibly acme of transgression); Eremophila 2 at 205m (base of transgression), 200m and 175m (two acmes of transgression?), 173m (regressive episode).

221 - 209m (11 samples)

Grey silty mudstones, micaceous (muscovite mica flakes).

An agglutinating foraminiferal fauna is present and is dominated by saccamminid and hyperamminid individuals. The fauna represent a small periglacial marine episode and part of it can be correlated to Dampiera 1A at 207m and Eremophila 2 at 152 to 149m.

121 - 118m (5 samples)

Grey claystones and mudstones, laminated, rare silty laminae, abundant plant remains (megaspores). A reducing environment of deposition is suggested by the strong reaction of the samples with oxidising agents. Rare agglutinating foraminifers are present, mostly hyperamminid and subsequently saccamminid and reophacid.

The fauna seems to indicate a very restricted environment, possibly of a fjord-type, with abundant megaspores, which are in general well preserved. It can be correlated to Eremophila 2 at 128 - 125m.

EREMOPHILA 2 205 - 200m (5 samples)

Grey, indurated, silty to sandy mudstones, with rounded or polished quartz and lithic grains at 205 - 201m, some pyritic aggregates at 201 and 200m and some bituminous aggregates at 200m.

Rare crinoid fragments at 200m.

The foraminiferal fauna is represented by the agglutinating hyperamminid, textulariid, ammodiscid and saccamminid forms, complemented by calcareous foraminifers and typified by syzraniid and protonodosariid (nodosinellid) species at 200.1m; the presence of *Tezaquina clivuli* in this sample indicates its relationship with Calytrix 1 at 199m and subsequently with Dampiera 1A at 295m, and Ficus 1 at 304m.

A periglacial transgressive episode (205m near base of transgression) is indicated, with a more open marine environment at 200.1m.

177 - 173m (5 samples)

Grey silty mudstones, rare pyritic aggregates, some sandy lenses. Small fragments of bryozoans and echinoids at 177-175m. The foraminiferal fauna is represented by hyperamminid, textulariid, ammodiscid, and saccamminid forms, complemented at 175m by calcareous perforate and imperforate foraminifers, suggesting an overall similarity with the sample at 200m. Accordingly another brief transgressive episode is indicated (base of transgression at 177m, base of regression at 173.25). The marine environment seems to be less restricted at 177 to 175m. The fauna can be correlated as the preceding one.

153.40 - 152.40m (2 samples)

Grey varvate clay with mica flakes and common plant remains. Rare megaspores. Some pyritic aggregates and sideritic(?) crystals. No foraminifers. A glacial (lacustrine?) environment is suggested.

151.85 - 149.5m (3 samples)

Grey mudstones, silty at 150.1m; relatively abundant plant remains; some mica flakes. The fauna is represented by rare hyperamminid, saccamminid and trochamminid forms. A correlation seems to be possible with part of Ficus 1 at 220 - 209m and Dampiera 1A at 207m. A small periglacial marine episode with an overall cold, restricted, reducing environment is suggested.

128.6 - 125.4m (4 samples)

Grey silty mudstones with abundant plant remains, common megaspores, common mica flakes. The fauna is represented by hyperamminid and saccamminid forms. It indicates a periglacial environment and can be correlated with Ficus 1 at 121 - 118m.

AGE OF THE FAUNAS

By comparison with and as a complement of the faunas already retrieved from Calytrix 1 and Dampiera 1A, an Early Permian (Asselo-Sakmarian) age is attributed to the assemblages contained in these glacio-marine sediments.

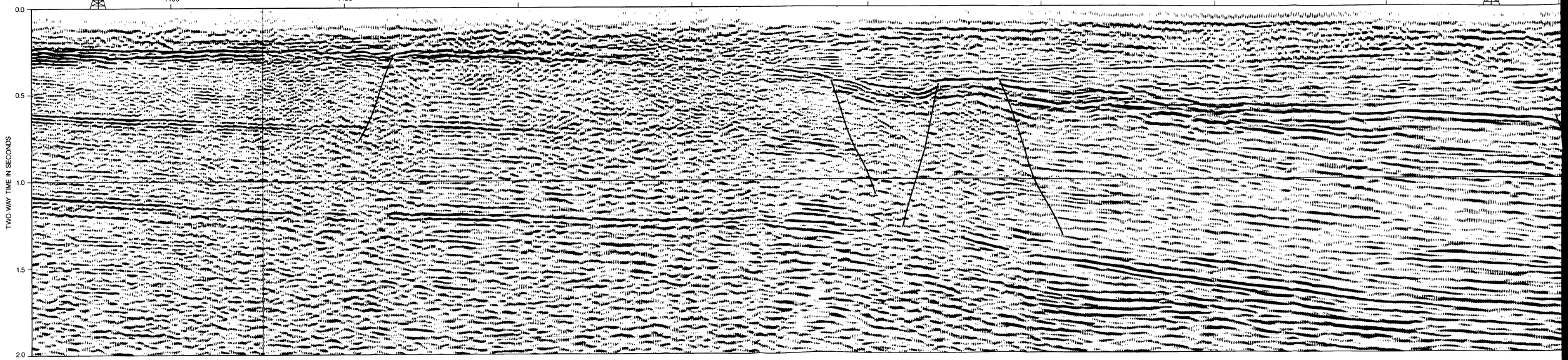
TABLE 1

WELL NAME	DATE	TD	CORED INTERVAL	BASE GRANT	TWT	TOP GRANT	TWT	THICK-NESS	TOP HOYA	THICK-NESS	TOP CALYTRIX	THICK-NESS	TOP CLIANTHUS	THICK-NESS	SUBCROP
ACACIA 1	19.8 81	1208.7	39 - 1208.7	361.6	312	41.50	38	320.10	215	146.60	139	76	41.50	97.50	TS
ARISTIDA 1	18.10.83	216	112 - 216	206.0				102+	153.60	52.40					NLE
ARISTIDA 1A	28.10.83	734	154 - 734	205.15				70+	151.40	53.75	145.20	6.2			NLE
BOAB 1	23.9.81	1033.4	141 - 1033.4	209.50				209.50+							
CALADENIA 1	5.9.83	296.5	80 - 296.5	139.18	126			139.18+	109.55	29.63	35.80	73.75		35.80+	NLE
CALYTRIX 1	29.4.84	450	84.5 - 450	396	199	78		318	222	174	143.5	78.5	78	65.5	NLE
CASSIA 1	2.11.81	850.3	129 - 850.3	549.9		45.8		504.1							F
CAPPARIS 1	21.1.84	521	19 - 521	212.40	158	23?	0	189	168	44.4			23?		PLE
CLIANTHUS 1	14.5.84	450	112 - 450	450+		148.5	70	301.5	324	126	224	100	148.50	75.5	NLE
DAMPIERA 1A	10.2.82	1856.9	129 - 1856.9	377.95	348	75		302.95	298.25	79.70	135 ?	163.25	75	60	F
DROSSERA 1	30.3.84	450	46 - 450	440.55	351	60?	93	380.55?	60?	380.55?					C
EREMOPHILA 1	6.4.82	1252	115.5 - 1252	195.60	184	43?	48	152.60	174.30	21.30	97?	77.30	43?	54	NLE
EREMOPHILA 2	1.12.83	360	91 - 360	228.16	232	33?		195.16	177	51.16	85	92	33	52	NLE
EREMOPHILA 3	7.12.83	464	75 - 464	295	276			295+	193	102	78.30	114.70			NLE
FRANKENIA 1	1.2.84	479	42 - 479	248.25	226	42	57	206.25	192	56.25	162	30	42	120	NLE
FICUS 1	5.1.82	1083.7	90 - 1083.7	474.30	348	50?		424.30	313.40	160.90	171.20	142.20	50?	121.20	F
GOODENIA 1	21.11.83	163.3	102 - 163 3	105.20	130	50?		105.20?							NLE - F?
HALGANIA 1	17.8.83	500	133 - 500	309.17	284	26	38	283.17	228.55	80.62	104?	124.55	26?	78	F
HOYA 1	7.5.84	450	85 - 450	434.40	249	71.80	-3	362.60	214.40	220	145.50	68.9	72	73.50	NLE
KUNZEA 1	27.5.84	450	8 - 450	261.40	254	29.50	70	230.90	?						C
MELALEUCA 1	11.4.84	450	78 - 450	450+		107.68	106	342.32	261.66	188.34	213.91	47.75	107.68	106.23	F
PANICUM 1	21.3.84	278	108 - 278	179.34	160	33?	41	146.34?							PLE
PRATIA 1	12.2.84	464	22.5 - 464	299.62	262	46?	38	253.62	232	67.62	152	80?	46?	106	PLE
SANTALUM 1A	24.9.83	629.30	252.75 - 629.3	321	256	110	83	211	196	125	173.50	22.50	110	63.50	C
SOLANUM 1	22.2.84	834	6-47 93-834	137	141			137+							C
TRIODIA 1	6.1.84	631	139 - 631	195.60	192			195.60+	167.25	28.35	49	118.25		49+	NLE
TYPHA 1	11.3.84	395	106.5 - 395	225.53	208	30	48	195.53	123?	102.53					F

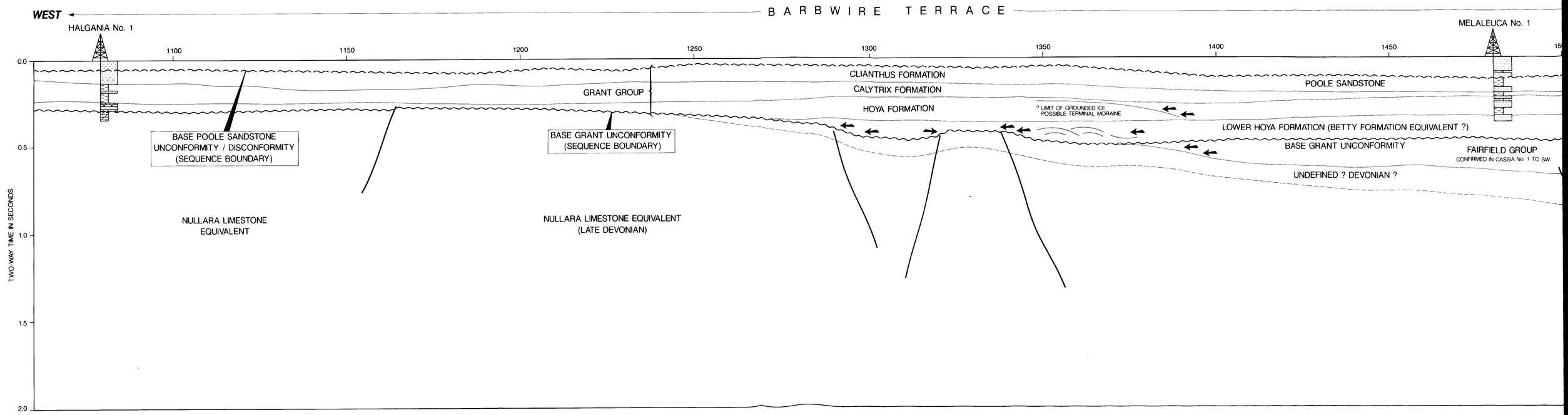
NOTES: *1. All depths and thicknesses are given in metres. 2. Two-Way Time (TWT) given in milliseconds. 3. + indicates top or base not recorded. 4. Bold typeface = cores examined Normal typeface = boundaries log picks and preliminary. 5. ? uncertain boundary. 6. SUBCROP TS = Tandalgoo Sst. NLE Nullara lmst Equiv. PLE = Pillara Lmst Equiv. C = Carribuddy Fm F = Fairfield Group 7. Date = spud date for well.*

ENCLOSURE

SEISMIC SECTION



GEOSEISMIC INTERPRETATION



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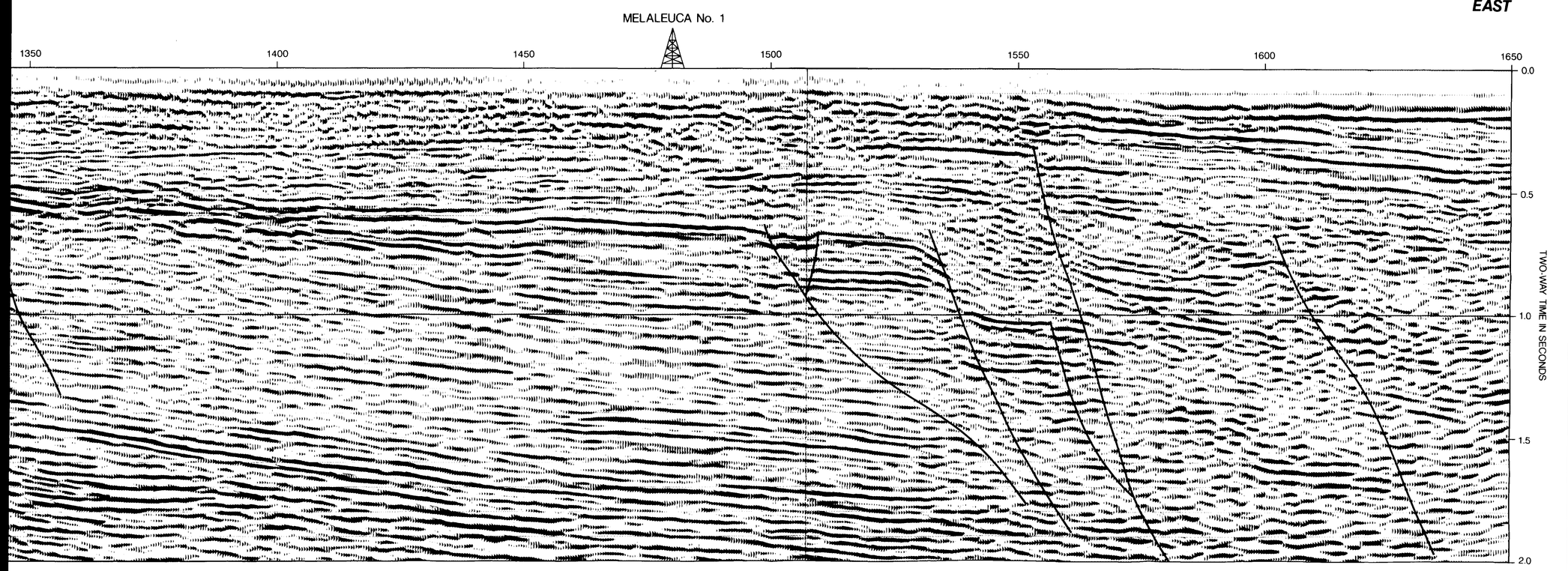
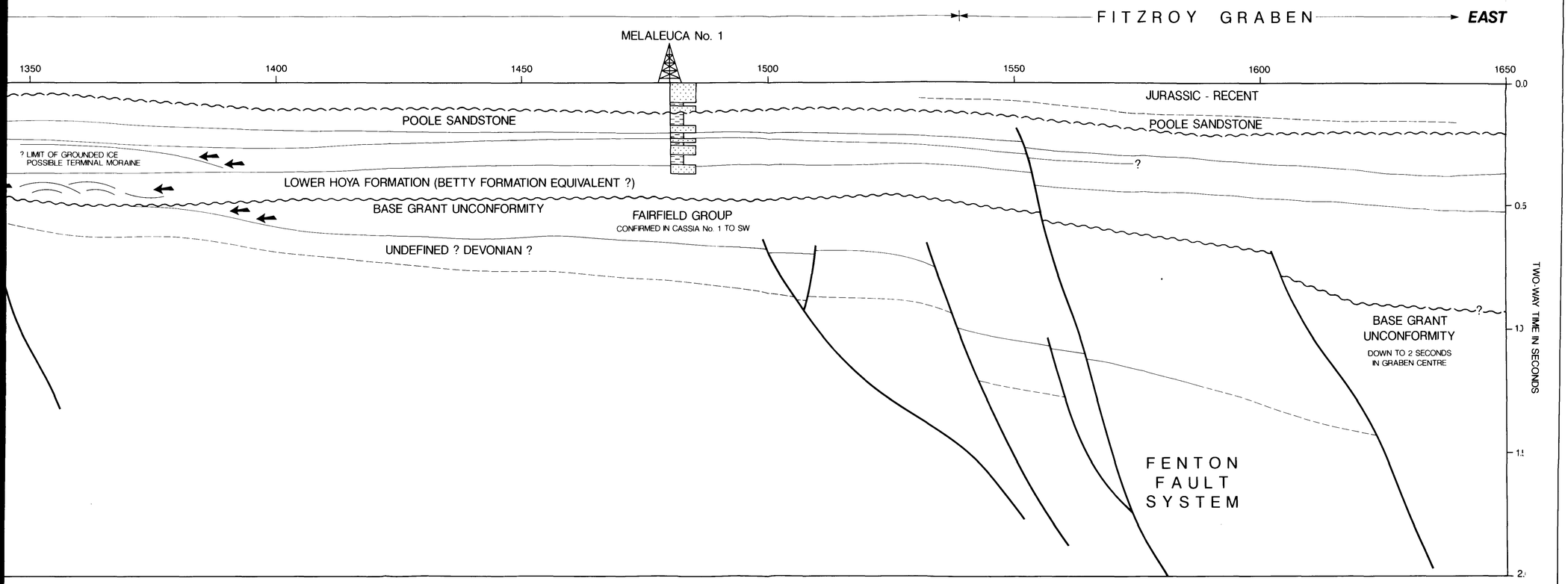


C INTERPRETATION



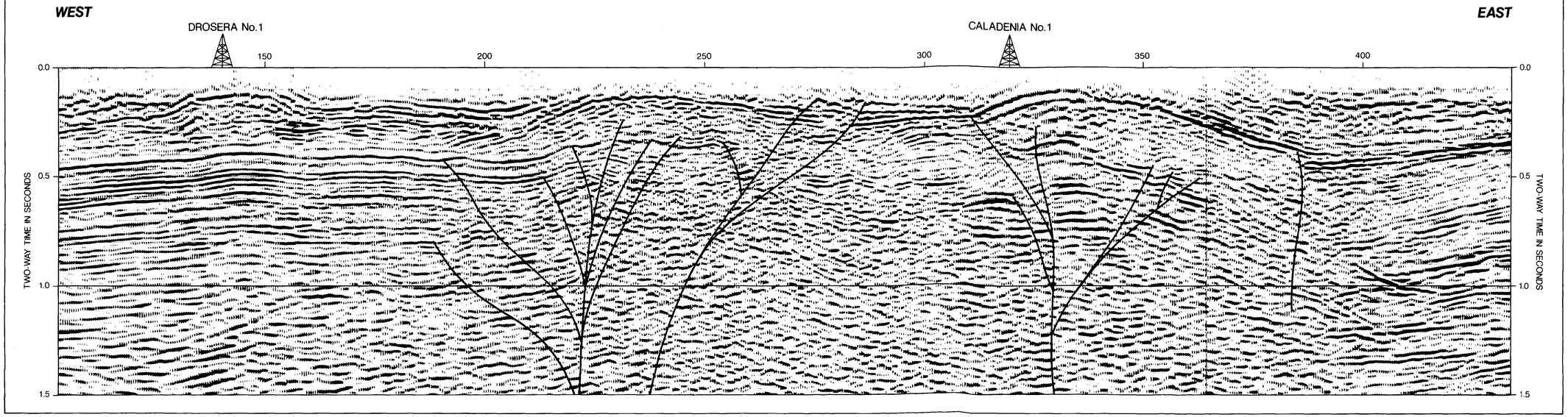
1 KILOMETRE

CANNING BASIN
WESTERN AUSTRALIA

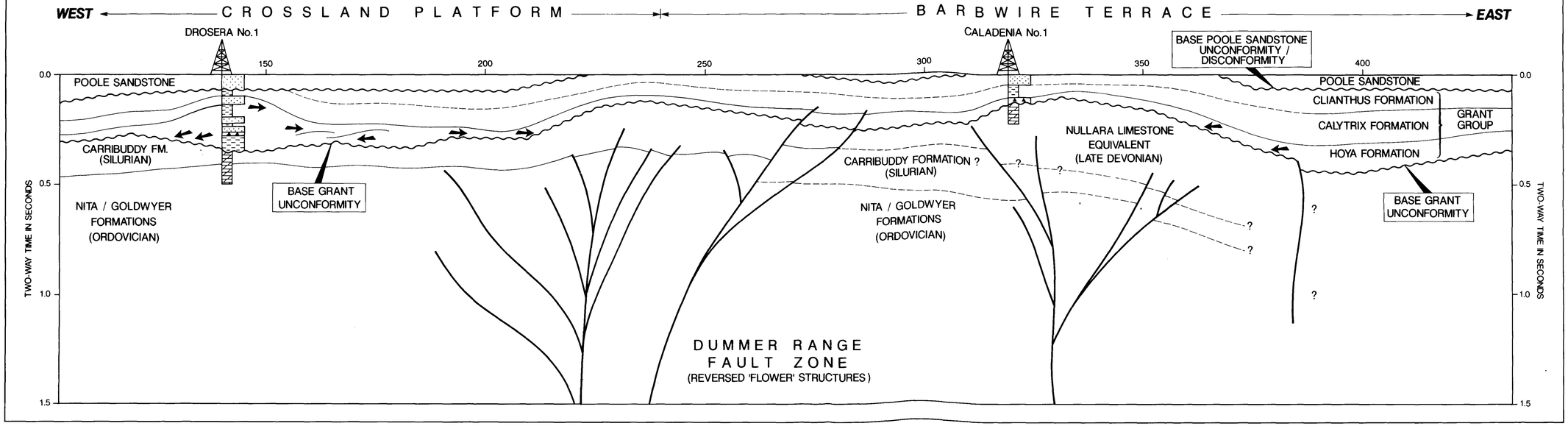
LINE W82 - 24
SP 1060 - 1650
SEISMIC SECTION AND INTERPRETATION

ENCLOSURE 1

SEISMIC SECTION



GEOSEISMIC INTERPRETATION



1 KILOMETRE

CANNING BASIN
WESTERN AUSTRALIA

LINE W82 - 24
SP 110 - 440
SEISMIC SECTION AND INTERPRETATION

ENCLOSURE 2